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APPLICATION, ELECTRODEPOSITION, VITREOUS ENAMELLING, GALVANIZING, METAL SPRAYING and all METAL FINISHING PROCESSES

Vol. 4 No. 47 (New Series) NOVEMBER, 1958

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THIS JOURNAL IS DEVOTED TO THE SCIENCE AND TECHNOLOGY OF PAINT APPLICATION, ELECTRODEPOSITION, VITREOUS ENAMELLING, GALVANIZING, ANODIZING, METAL SPRAYING & ALL METAL FINISHING PROCESSES. THE EDITOR IS PREPARED TO CONSIDER FOR PUBLICATION ANY ARTICLE COMING WITHIN THE PURVIEW OF "METAL FINISHING JOURNAL" AND ALL SUCH ARTICLES ACCEPTED WILL BE PAID FOR AT THE USUAL RATES.

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Long hours spent on the road exposed to pouring rain, fog and snow:

these are the conditions which every vehicle in Britain must endure.

Obviously, the danger of rust is great — particularly the insidious

spread of corrosion beneath the paint, resulting in finish failure.

To combat this menace, many manufacturers of both passenger

and commercial vehicles insist upon

BONDERIZING

The processes for bonding paint to metal surfaces

THE PYRENE COMPANY LIMITED — METAL FINISHING DIVISION

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ND OF AN ERA

IT has been said, presumably by some egregious observer of human foibles, that at any mixed gathering the ladies will get together to talk shopping while the men congregate to talk shop. While discussion on this page on the purchasing policies of the fair sex would be out of place, we can certainly confirm from our own experience the readiness to discuss plating and its problems which is evinced by electrodepositors in inns, clubs, lecture rooms and other places where they foregather. In fact, the electroplater probably manifests a greater readiness to discuss the techniques of his craft than does almost any other technologist, and listening to the tenor of these discussions as they take place up and down the country, it is clear that a very great proportion of them is devoted to the subject of nickel.

Nickel, its supply or the lack of it, its brightness, or the lack of it, its adhesion or the lack of it, in fact all its many vagaries when used as a deposited coating, are constantly topics of keen and often controversial debate.

Two major factors have overshadowed and frequently bedevilled the development of nickel/chromium plating in the post-war years ; one of these has been the development and availability of a wide range of solutions capable of depositing nickel in the fully bright condition, the other has been the consistent difficulty, and at times impossibility, of obtaining adequate supplies of the metal itself.

It was therefore particularly interesting in relation to the latter issue to hear Dr. J. F. Thompson, chairman of the International Company of Canada Ltd., say in London recently that the era of shortage was ended and that supplies of nickel for all present and anticipated applications would be adequate for the foreseeable future. Specifications for nickel/chromium plating drawn up in recent years have taken cognizance of the supply position and economies in nickel consumption by reducing the thickness of nickel under chrome have been frequent, with consequent repercussions on the quality and service life of the final finish.

The banishment of the bogey of shortage should signal immediate and urgent rethinking on the subject of coating thickness. No one can blind themselves to the fact that much of the criticism levelled at the performance of nickel/chrome in service is well founded, and there is ample experimental evidence to show that the porosity to which nickel coatings are subject decreases significantly with increasing thickness of deposit. The immediate answer therefore, would appear to be to apply forthwith a nickel coating which shows itself under performance testing to be able to guarantee a reasonable life in service, but it is at this point that the significance of the other major development in the field of nickel plating makes itself felt. The advent of bright nickel and the elimination of the need for nickel polishing prior to chrome plating, has made possible the mechanization of the process on a considerable scale. Articles, once jigged, remain on the jigs through the whole cycle from cleaning to chromium. The cycling of modern mechanized plating plants has been devised in the light of the thickness of nickel coating commonly applied and to make any significant alteration in the length of the nickel cycle in order to produce a thicker deposit presents numerous engineering problems. Nevertheless they are problems which will have to be faced now that the plea of shortage of nickel is no longer acceptable as an excuse for the application of a coating of less than adequate thickness.

Talking Points

by "PLATELAYER"

TOPICAL COMMENT FROM THE MAIN LINES AND SIDE LINES OF METAL FINISHING

THE ART OF LISTENING

THE lecture season is now in full swing, and once more we can exercise the art of listening—and a difficult art it is. Listening is a very good, but at the same time very slow, method of assimilating information. This arises from the fact that whilst the average person talks at something like 120 words a minute, it is possible to assimilate information comfortably at a rate of 500 words per minute. This gives the mind plenty of time for wandering and thinking about something else whilst the speaker is talking.

It is for this reason that some people find listening to a difficult subject more easy than to a simpler exposition. There is a need to keep track of the subject whilst the speaker is talking and no time for the attention to be diverted to something else.

Advice to the quick-witted. Attend meetings where difficult papers are presented or where the discussions are likely to be of interest. Stay at home and read the easy ones.

SOME PAINT

IN 1955 some comment was made in this column that the royal yacht "Britannia" had had its fifth repaint in 15 months. The yacht is now being repainted again — for the fifth time in four years, which is quite an improvement.

However, it must not be assumed that the navy cannot produce some pretty durable paints when the need arises. When the Israeli navy recently took over H.M. Submarine "Springer," they found that the submarine's former ratings had painted a kangaroo on the bridge as its emblem. As the boat was to be re-named "Crocodile," the presence of this beast was hence singularly inappropriate. It was therefore decided to obliterate the kangaroo before the handing over ceremony, and here the trouble started. Apparently several coats of heavy black paint and even chipping of the surface failed to eliminate the outline which could still be seen when its new owners took over !

MECHANIZING THE HOME

BY any standards, Britain lags far behind the U.S.A., and many other Western countries in the extent to which its homes are equipped with what are called durable household goods. Yet it is just this kind of equipment which offers the largest potential to the metal finisher, so that any increase in the sale and utilization of modern amenities of civilization is of direct interest to the industry. A recent survey showed that less than a quarter of the households in the country had a washing machine or a motor car, while only 12 per cent possessed a refrigerator, so there is plenty of scope for salesmanship. In fact, the sum total of the needs of the average household so far as this kind of equipment is concerned seems to be satisfied by the acquisition of a television set and a lawnmower.

However, there is still hope that things will improve, because it is by no means certain that the trouble is due to lack of purchasing power. American influence is an important factor in stimulating demand for this kind of product and this is steadily increasing. In this connexion it is worth while pointing out that no less than 40 per cent of Britain's total exports of new industrial products (produced commercially since the 1930's) are accounted for by American financed firms. Sooner or later they will turn their attention to the home market, where the scope is evidently considerable.

Motivation research may be instructive here. Do people buy refrigerators primarily to keep the milk cool or because their neighbours or friends have one? It is currently estimated that a bricklayer or a coal miner has to spend only half to one-third of the number of weeks' wages to acquire such articles as he did before the war; in the case of bank managers and doctors the position is almost exactly reversed. Possibly there are not yet enough bricklayers' neighbours who have refrigerators to stimulate the demand !

SUPER-SENSITIVITY

AN interesting new method of testing cleaning efficiency based on ultrasonics has been developed in the U.S.A., which apparently gives results of an astonishing standard of accuracy. It is based on the fact that the resonant frequency of a quartz crystal is dependent on its thickness $F \times T = K$. Hence, the presence of a trace of soil on the crystal will increase its thickness and reduce its vibration frequency.

Thus it can be calculated that for a quartz crystal to have a resonant frequency of 25 megacycles it must be .00253 in. thick. If this thickness is increased by only 0.1 per cent, its frequency will fall by 24,975 cycles. Such frequency changes can be measured with excellent accuracy, and it should be theoretically possible to detect contaminant thicknesses of the order of a ten thousand millionth of an inch !

New £3,000,000 Paint Plant

Completed at the Cowley Works of THE BRITISH MOTOR CORPORATION LTD.

A NEW £3,000,000 paint plant for car bodies has recently been completed at the Cowley, Oxford, works of the British Motor Corporation Limited. Covering an area of 7 acres, the new plant takes " bodies-in-the-white " through phosphating and the usual painting processes, after which they are trimmed and transported to the final assembly lines.

The new paint shop is built on a site which was formerly the employees' car park and the design of the plant installed was finalized by a planning committee set up within the works for that purpose. The need was for additional paint capacity with higher-temperature stoving facilities to use synthetic paint throughout replacing the cellulose paint lines used in the old paint shop. The company had proved to their own satisfaction that the durability of synthetic paint is greater than cellulose in particular from the point of view of retention of gloss. The whole of the new plant was designed and built by the Carrier Engineering Co. Ltd.

The old paint shop had four lines, two with an output of 20 bodies per hour each, and two 12½ bodies per hour each, making a total output of 65 bodies per hour. Two of these lines used cellulose and two synthetic paint ; the cellulose lines are not now being used.

The new plant consists of two separate lines, virtually identical, each capable of processing 26 bodies per hour, so producing a net gain in output over the old set-up of 27 bodies per hour.

In the new plant automatic spraying is used wherever possible, although as the new lines have to cater for a wide range of body sizes, it was not possible to make the plant completely automatic. The arrangement in use at the present time, therefore, is that on both lines the undercoats are applied automatically, one line also has automatic spraying for the colour coats and the other uses hand spraying for the colour coats.

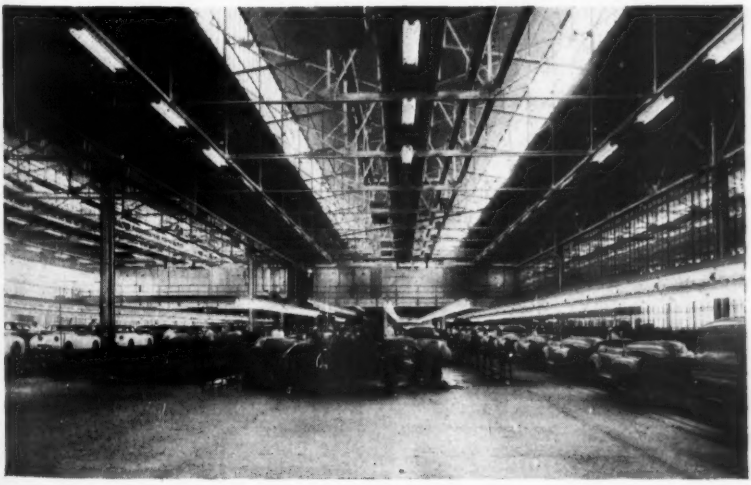


Fig. 1.—General view of new paint plant. The Minor 1000's in the centre foreground have received two coats of surfacer and are passing through the rubbing-down stage prior to sealing. In the middle distance are the baking ovens on the mezzanine floor.

(Courtesy of the British Motor Corporation Ltd.)

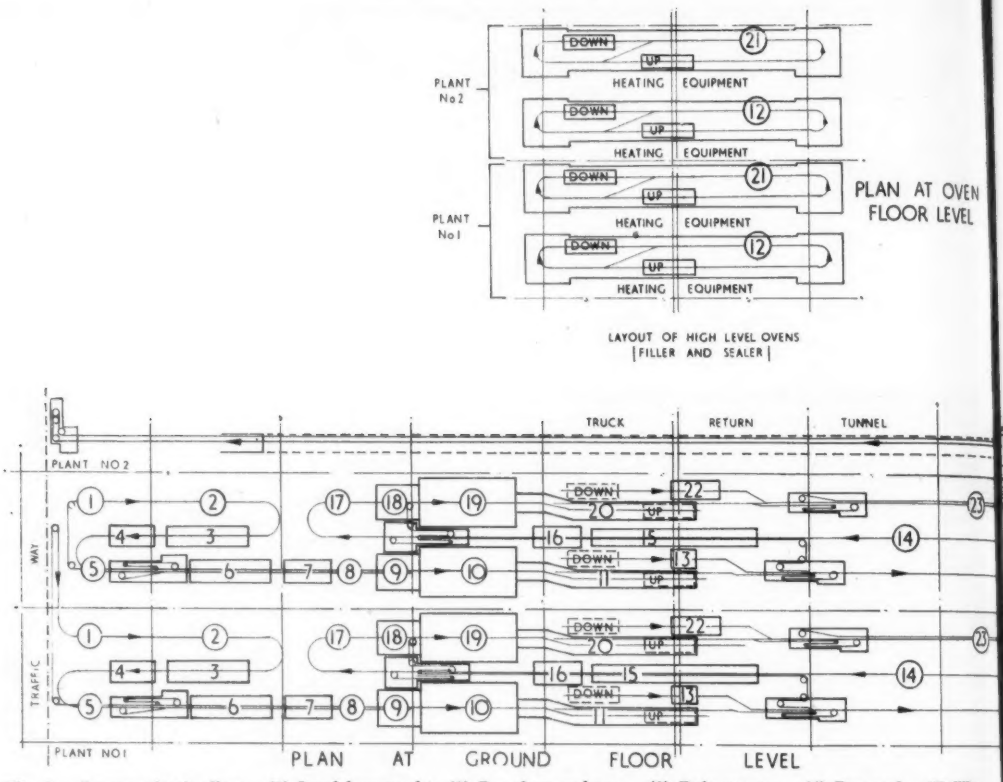


Fig. 2.—Layout of paint lines. (1) *Load from stock.* (2) *Pre-clean and stop.* (3) *Bake stopper.* (4) *Dry cool.* (5) *Wet-face stopper.* (6) *Dry-off.* (7) *Dry cool.* (8) *Spirit wipe .* (9) *Tack-rag.* (10) *Spray filler.* (11) *Flash-off.* (12) *Bake filler.* (13) *Wet cooler.* (14) *Wet rub.* (15) *Dry off.* (16) *Dry cool.* (17) *Touch up and spirit wipe.* (18) *Tack-rag.* (19) *Spray sealer.* (20) *Flash off.* (21) *Bake sealer.* (22) *Dry cool.* (23) *Dry scuff*

" Rotodip " Plant

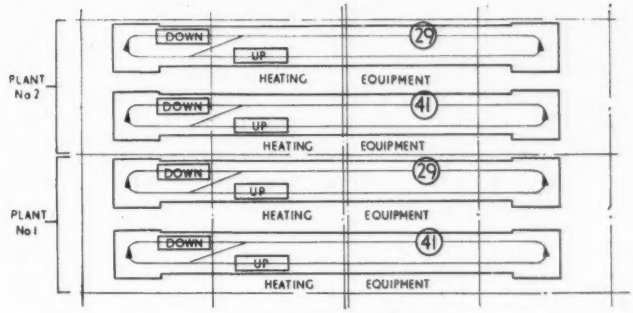
Prior to painting, the bodies will pass through a new " Rotodip " plant in the new shop or through an existing installation in another part of the works. It is proposed to start up the second plant in the new shop in the near future.

The new " Rotodip " plant incorporates underground storage tanks for both the Bonderite solution and the raw and mixed primer. Automatic pumping equipment for the main tanks is also incorporated. The plant is, in the main, similar to the old plant except that automatic filtration, by moving bands of filter paper, is used for the Bonderite solution. The throughput of the new " Rotodip " is 26 per hour.

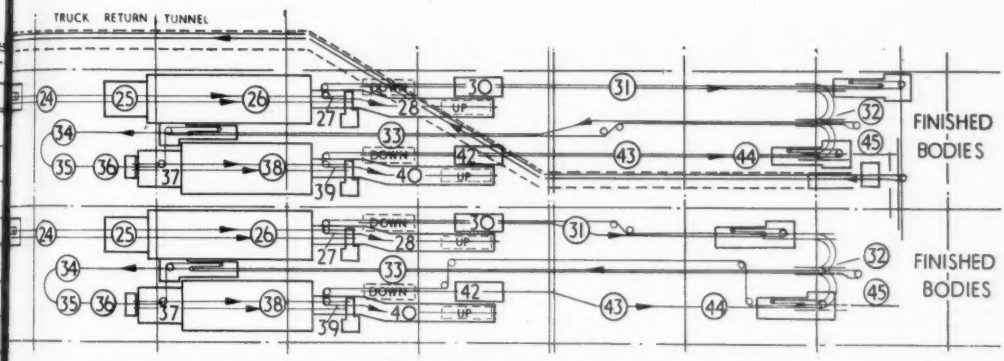
Automatic loading and unloading equipment is being installed on the new Rotodip so that the " body-in-the-white," on its " spit " is raised by transporter and conveyed to the entrance end of the plant, where it is automatically transferred into forked dogs on the Rotodip conveyor chains. A sprocket on the end of the " spit " rotates the body in the various tanks to prevent the formation of runs, etc. ; this type of defect has been still further reduced by the adoption of epoxy-based primers. The rotation speeds can be varied according to requirements. The sprocket on the spit can either engage a fixed or a moving rack according to the speed of rotation specified.

In the " Rotodip " the following operations are carried out : emulsion clean ; cold-water rinse ; hot-water rinse ; Bonderite treatment (160-170°F) ; hot-water rinse ; chromic-acid rinse. The body shell passes into an oil-fired convection-type oven where it is dried at 300°F. Bodies are not rotated in the oven. After drying, the shell is transferred to a slower-running conveyor on which it is dipped and rotated in the epoxy primer, followed by draining and stoving in an oil-fired camel-backed convection oven at about 325°F. for 35 min. ; rotation is effected if required.

When the body shell leaves the oven it trips a limit switch which sets the automatic unloading equipment in motion. A transporter removes



LAYOUT OF HIGH LEVEL OVENS
(MONOTONE AND DUOTONE)



and rectify. (24) *Auto transfer.* (25) *Tack-rag.* (26) *Spray monotone colour.* (27) *Auto transfer.* (28) *Flash-off.* (29) *Bake monotone.* (30) *Dry cool.* (31) *Inspect.* (32) *Unload monotones and return duotones and rejects.* (33) *Wet scuff and rectify.* (34) *Mask duotones.* (35) *Wipe over.* (36) *Auto transfer.* (37) *Tack rag.* (38) *Spray duotones and repairs.* (39) *Auto transfer.* (40) *Flash-off.* (41) *Bake.* (42) *Dry cool.* (43) *Demask.* (44) *Inspect.* (45) *Unload.*

(Courtesy of B.M.C. and Carrier Engineering Co. Ltd.

the body complete with spit and lowers the whole unit onto a turntable and when the clamps holding the spit are released the spit is automatically withdrawn from the shell and returned to the loading end of the plant.

The body shells are then placed on individual trolleys which are adjustable for height and pass out into a storage bank. Although the adoption of the epoxy-based primer in the Rotodip has virtually eliminated " runs ", any necessary rectification is carried out at this stage.

Layout of Paint Lines

The plant in the new paint shop is laid out on four levels. All hand-operated production operations such as wiping, spraying, sanding and inspection, etc. are arranged to take place at shop floor level, but all other functions such as running attention and maintenance necessary to keep the plant operating continuously and efficiently are carried out either above or below shop floor level.

For example, the four main paint baking ovens for filler, sealer, monotone and duotone are mounted on mezzanine floors and the bodies, after leaving the spray booth, travel up an inclined section of the conveyor and enter the oven through a hole in the floor and descend to shop floor level after stoving. Thus the space under an oven is usefully employed for unproductive operations such as flashing off and cooling down after baking. Another important thermal advantage is that the ovens are the equivalent of " camel-backed " and are therefore self sealing ; there is virtually no spillage of hot air from the ovens.

The indirect oil-fired heaters are all grouped very accessibly on a steel platform above the ovens. Penthouses are provided for the air-conditioning plant.

Direct oil-fired ovens are provided for drying the stopper coats ; for drying after wet facing the stopper, one line has a direct oil-fired oven and the other an infra-red electric oven (using Metro-Vick elements), built by B.M.C.

The basement houses the desludging plant and

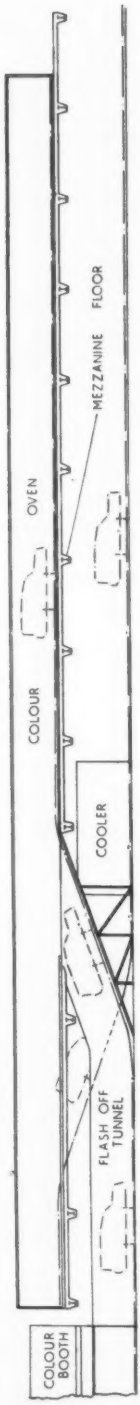


Fig. 3.—(above) Section through line, showing method of elevating body shells to ovens on mezzanine floor.

Fig. 4.—(above) Spray booths (left to right) Filler No. 2 line ; sealer No. 1 line ; Filler No. 1 line.

(Courtesy of Carrier Engineering Co. Ltd.)

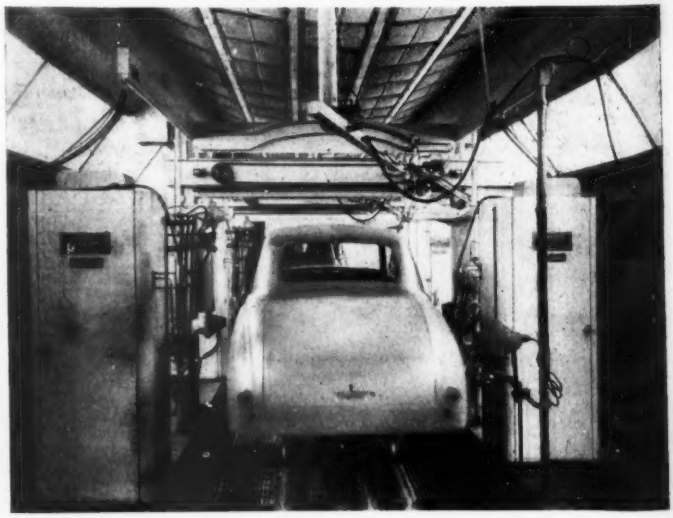
Fig. 5.—(below) Filler coat booth (No. 1 line) with two Carrier-Schweitzer automatic spray machines.

(Courtesy of Carrier Engineering Co. Ltd.)

the mixing equipment for the undercoats. The above arrangement of the plant gives an average ground floor working temperature of 65°F. and saves 30 per cent of floor space compared with an all-ground-floor layout of similar capacity.

Spray Booths and Desludging

The spray booths are of the down-draught water-washed type and although conventional in general form they are the result of a long development programme. The shape of the roof, for example, is such that the air flows through the booth without eddies. The exhaust air scrubber units have also been the subject of considerable development, giving a marked improvement in cleaning efficiency. Water flows down both sides



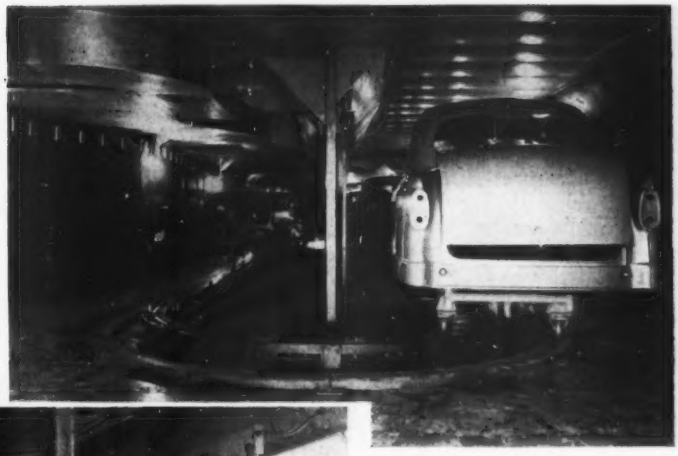


Fig. 6.—(right) Interior of filler-coat oven on mezzanine floor (No. 1 line).
(Courtesy of Carrier Engineering Co. Ltd.)

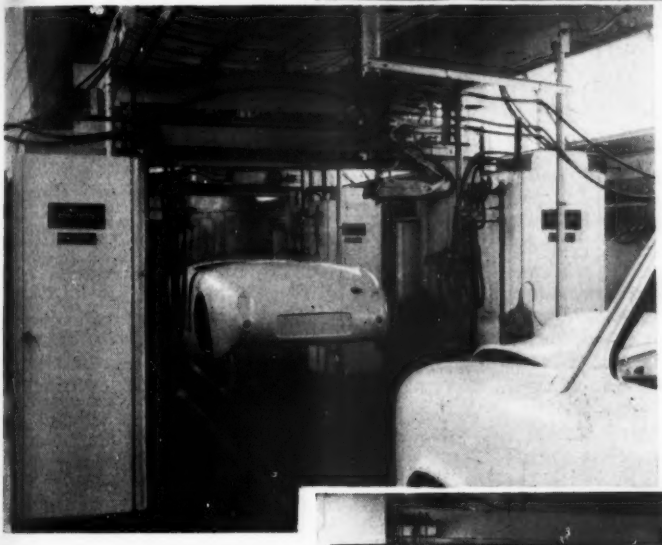


Fig. 7.—(left) Monotone booth (entry end).
(Courtesy of Carrier Engineering Co. Ltd.)

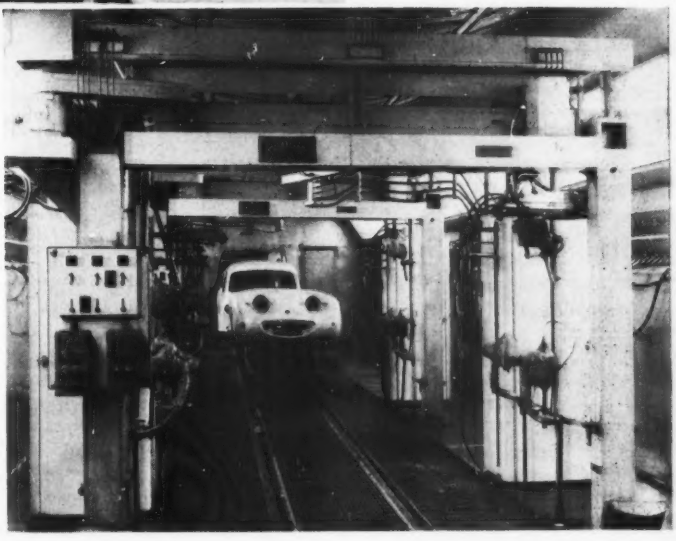


Fig. 8.—(right) Monotone booth (exit end).
(Courtesy of Carrier Engineering Co. Ltd.)

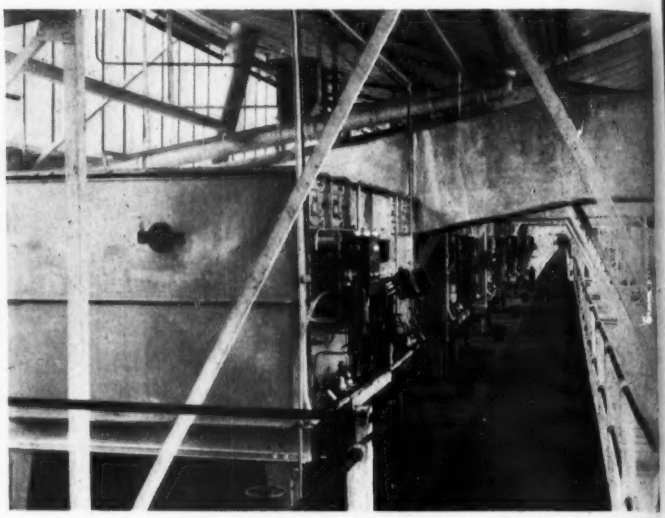


Fig. 9.—Indirect oil-fired heaters serving monotone and duo-tone ovens (No. 1 line) mounted on gallery over ovens.

(Courtesy of Carrier Engineering Co. Ltd.)

of the booth to a central flume underneath the booth and thence to the weir feeding the desludging tanks in the basement.

In the booths paint lines are located behind false panels and access to the scrubbing chambers for maintenance is from the outside.

For desludging, two large underground chambers, one for the four undercoat booths and one for the four colour-coat booths, were excavated in the basement. The lower portion of each chamber is water-proof lined and thus forms a tank of some 50,000 gal. capacity.

The water from each spray-booth scrubber section enters the underground tank *via* a system of flumes and distribution troughs in which the water speed is at all times high enough to prevent the settlement of sludge. The water enters the appropriate tank through a system of weirs which controls the aeration and eliminates large bubbles which rise to the surface and burst. As only small bubbles remain, the effective aeration is high, giving a greater flotation effect to the sludge.

Once the water enters the settling tank it travels under slow laminar-flow conditions thus permitting the paint overspray to float on the surface, or alternatively to sink to the bottom in the form of sludge.

The water is treated with alkali to encourage 90 per cent or more of the overspray to float. At the other side of the settlement tanks the water passes through filter screens which are continuously back-flushed with high-pressure water jets to prevent any build-up of paint occurring. Operating experience has shown that, under normal conditions, these filter screens will never have to be manually cleaned. The water is then picked up by vertically mounted centrifugal pumps and re-circulated to the spray booths. The cleaning system has a high efficiency, and in seven months of operation no spray nozzles in the scrubbing chambers have yet been found blocked with paint.

Over each tank is a double rail track on which runs a manned mechanically propelled trolley, carrying at runnion-mounted skip. When the floating paint scum is of sufficient depth the trolley traverses the tank scraping the scum into the skip which, when full, is passed through a hole in the basement wall into an area basement from where it is elevated to ground-floor level. Here the skip is transferred to a trailer truck on which it is transported to a dump area.

Air-Replacement and Paint Supplies

The air-replacement plants for the spray booths are mounted in two penthouses, one of which contains the plant for the undercoat booths and the other for the colour booths.

The plants use " Kompak " filters for the main filtration stage and the air enters each booth through a double thickness of " Fibreglass " cells. The colour booth plants incorporate humidifiers with dewpoint control in order to maintain a controlled relative humidity in the booths.

The penthouses also contain all the exhaust fans serving the spray booths; thus all maintenance can be carried out on this equipment without entering the production area of the paint shop.

A very comprehensive paint storage, mixing and distribution system has been installed to serve the paint shop.

The four undercoat booths have their own mixing house located in the basement as near as possible to the spray booths to keep the pipe circuits as short as possible. Facilities are provided for three sealer circuits and two filler circuits, each circuit

Fig. 10.—One of the 50,000-gal. underground sludge tanks. Water from underneath the spray booth can be seen entering the tanks over the weir on the left. The floating paint residue is directed to the right side of the tank by the force of the returning water. A trolley (which can be seen at the far end of the tank on the right) runs on rails and is used by the operator to skim the sludge from the surface.

(Courtesy of B.M.C.)

including a pair of water-jacketed paint mixing pots, pneumatically-driven reciprocating agitators and an electrically-driven circulating pump.

Douglas rotary pumps are used for sealers and Evans reciprocating pumps for fillers. A system of storage racks for 40-gal drums is provided together with mechanical-handling equipment for loading and unloading the racks, and a special hoist for bringing the drums down to the mixing room from lorries at road level. Two 1500-gal. thinners storage tanks, together with pumping and metering equipment are provided. The room has a plenum heating and ventilation plant including a "Rolomatic" self-cleaning filter.

The colour paint mixing house is a separate building, adjacent to the main paint shop and has similar facilities to the undercoat mixing room, but on a much larger scale. The ground floor of the building is used for paint storage, again mainly in the form of 40-gal. drums.

The colour mixing house proper is on the first floor of the building. Twenty-six colours are supplied to the colour booths, so that 52, 100-gal. mixing pots (two to each colour) are installed. As in the undercoat mixing room, mixing of the paint is by mechanical means. Each paint pipeline from the mixing room to the paint shop holds about 150 gal. of paint.

The method of preparing the paint is to fill one of the mixing pots with paint and to meter in, by means of a "petrol-pump" type nozzle, the predetermined quantity of thinners from a remote store. After mixing, the contents of the pot are pumped into the second pot from where it passes into the pipeline, at a pressure of about 70 lb. per sq. in. Paint flow is controlled by a throttle valve on the return pipeline, where the pressure is a maximum of about 35 lb. per sq. in.

In order to determine the right amount of thinners for each colour, the laboratory receives in advance from the manufacturers ½-gal samples of each paint batch on which viscosity measurements etc. are carried out. Master panels are sprayed for each new colour batch for reference purposes.

An interesting feature of the plant is a central control station, designed and built by Lee Beesley and Co. Ltd., at which pressure and flow throughout the paint system are indicated, and any defect immediately notified.

Great care has been taken to reduce the fire hazard to the minimum. The mixing room and paint stores are ventilated and maintained at a constant temperature. Electric wiring is run in Pyrotenax cable with screwed connexions at junction boxes and switches. All the walls are asbestos-lined, floors are non-skid, and all doors are fire-proofed. In each room a thermostatically controlled CO_2 spray system is installed.

Operational Sequence

In the paint shop the first operation is to pre-clean, stop up and dry for 10 min. at 270°F., followed by cooling. This is followed by a wet-face operation and wet and dry paper to remove any paint runs, etc. After wiping-off, the bodies then pass through the infra-red dry-off oven where the treatment conditions are 5 min. at 270°F. From the dry-off oven the body then passes through an air-blown cooling chamber following which the bodies are given a spirit wipe off and are tack-ragged.

The bodies then pass into the filler booth equipped with Carrier-Schweitzer automatic spray-

Fig. 11.—*Colour paint mixing house showing pairs of* 100-*gal. pots.*
(Courtesy of Carrier Engineering Co. Ltd.)

ing equipment. In the booths infra-red " electric-eyes " control the spraying equipment as the bodies progress through. Spray guns mounted on both sides of a booth are actuated by compressed air, and follow the approximate contour of a body shell as it passes through. The outer surface of the body, which is complete with boot lid, doors and bonnet cover, etc. attached to the main shell by " slave hinges ", is uniformly coated with paint with a minimum of overspray. Each booth has two operators to spray, manually, interior surfaces of bonnet and boot lids and other areas not presented to the automatic guns.

Two coats of filler are sprayed on, wet-on-wet, after which the conveyor takes the bodies, after flash off, up to the mezzanine level for baking in one of the indirect oil-fired ovens at 320°F. for 30 min. Following water-spray the body is given a wet rub, a dry-off at 300°F., is air-blast cooled, touched up, spirit wiped and tack-ragged.

After the single sealer coat is sprayed on, followed by a flash-off, stoving, in a mezzanine-floor oven is effected at 280°F. for 30 min. Passing down to the ground floor and through an air-blast cooling chamber, dry scuffing followed by rectification is carried out if required.

(*Continued in page* 428)

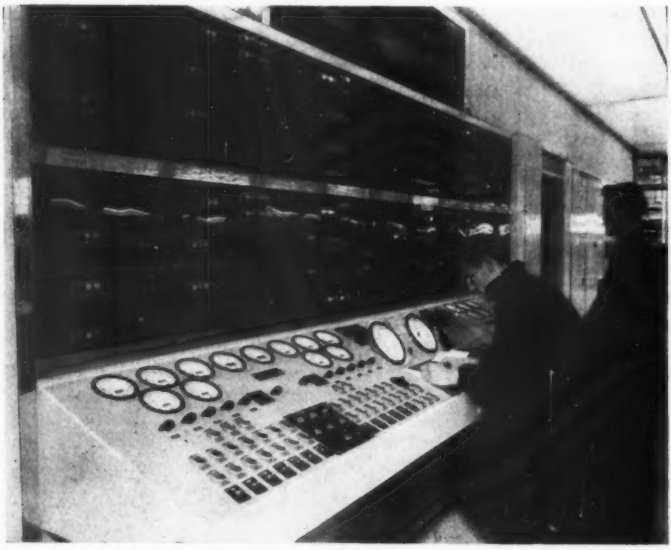


Fig. 12.—*The Lee Beesley control panel where a continuous watch is maintained over every section of the paint lines. A stoppage or fault and its exact location are immediately indicated.*
(Courtesy of B.M.C.)

FINISHING POST

A SELECTION OF READERS' VIEWS COMMENTS AND QUERIES ON METAL FINISHING SUBJECTS . . . . .

Advice on all aspects of metal finishing practice is offered on these pages, and while every care is taken to ensure the accuracy of information supplied no responsibility can be accepted for any loss which may arise in respect of any errors or omissions.

ALUMINIUM ADDITIONS TO GALVANIZING SPELTER

Dear Sir,

With reference to the very effective report of the recent International Conference on Hot Dip Galvanizing published in the September issue of METAL FINISHING JOURNAL, which I have read with much interest, I would be pleased if you would correct an error which occurs in the reporting of one of my own contributions to the discussion. It concerns a complete reversal of sense and is of some importance to the suppliers of galvanizing spelter containing added aluminium.

What I in fact stated was that " the addition of aluminium to spelter by the manufacturer . . . . appeared to be advantageous," not disadvantageous as reported in your text.

Yours faithfully,
H. EDWARDS.
Chief Chemist and Metallurgist.

John Summers and Sons Ltd.,
Chester.

THEORY AND USE OF SOLVENT DRIERS

Dear Sir,

The interesting and informative article on the theory and use of solvent driers published in the October issue of your journal effectively outlined the advantages and scope of this relatively new drying method.

Unfortunately however, a misleading impression may be gained by some readers of the efficiency of trichloroethylene in solvent drying. Your contributor quotes work carried out with the additive ASL presumably developed primarily for use with perchloroethylene. Recent work has shown that additives may be selected which permit highly efficient drying in trichloroethylene even in the presence of a considerable amount of water (*i.e* 5 per cent by volume at least). This means, in short, that work need not remain in the drying compartment until all dispersed water has vaporised but only until it has been displaced from the work. A typical drying cycle in this system consists of 20-30 seconds in the drying compartment followed by a rinse for the same period.

A practical test carried out on a two-compartment plant using trichloroethylene and the additive " Trisec " and having a total heat input of 11.1 kw. showed that 4.4 litres of water per hour could be removed from the plant. A similar plant heated by steam and consuming 82 lb. of dry steam at 30 p.s.i. gave a water removal rate of 5.6 litres per hour. These figures are 7 to 9 times greater than that for trichloroethylene in Table 1 of the above article. Water added in excess of these amounts remains in the drying compartment and does not affect the rate of drying: on the contrary it has the effect of keeping the temperature of this compartment at 73° C. and preventing " vapour surge " when further water is added.

Applications may of course exist where the use of perchloroethylene and a suitable additive would prove advantageous and such a system may be especially valuable when the maximum possible rate of water removal is required. In general, however, driers based on trichloroethylene are both compact in design and economy, and experience has shown that a plant of the above size is quite capable of coping with the throughput of a medium sized electroplating shop and, in fact, such plants are seldom worked to capacity.

Yours faithfully,
F. R. SHERLIKER, A.R.I.C.
Technical Service and Development Department.

Imperial Chemical Industries Ltd.,
General Chemicals Division,
London, S.W.1.

AUTOMATIC POLISHING OF HUB CAPS AT BASILDON

Dear Sir,

We were very interested to read in the October issue of METAL FINISHING JOURNAL an article describing the polishing and plating of hub caps at the Basildon Works of the Ford Motor Co. Ltd. We noted however, that no reference had been made to a new 6-head fast indexing rotary table which we have recently installed at these works for use on the same product. As your readers will no doubt be interested in this equipment details of it are as follows.

The Turret is a Morrisflex/Hammond Model K.62/7 fast indexing turret with infinitely variable production times enabling the production rate from

(*Continued in page* 428)

New £3,000,000 Paint Plant.

(*Continued from page* 426).

Following papering-down, a blow-out and a tack rag wipe, the bodies pass into the finishing coat spray booth. Here two coats of colour are applied wet-on-wet, and following a flash off, are baked in an indirectly-heated oil-fired oven on the mezzanine floor ; this takes 45 min. at 260°F. Following air-blast on the ground floor, touching up is carried out as required. Inspection is also carried out here.

For duotone the bodies are then wet scuffed, masked off, blown out, wiped over, and tack-ragged and two coats of duotone colour sprayed wet-on-wet, followed by a flash off and baking under the same conditions as the first finishing coats.

The total paint thickness applied to the bodies is 0.003 in. undercoat and 0.0015 in. colour coat. Paints are supplied by Pinchin-Johnson, I.C.I., Robert, Ingham Clark, Berger and Vulcan Products.

Conveyors

The comprehensive conveyor system, including overhead and floor type, installed by Geo. W. King, Ltd., is divided into 10 different sections, automatic transfer being provided where required. At the entrance to each colour booth the conveyor changes from the centre chain type to the slat type in order to allow some individual movement of bodies on the conveyor, if required, and also to allow the spray booths to be emptied for cleaning purposes.

The floor conveyors are shown in the layout drawing (Fig. 2). On line 1 conveyors on the undercoat section are of the single-strand type and are all synchronized. Conveyors through the monotone and duotone booths are double strand, and on the remainder of the line single strand. The conveyor layout is similar on line 2. Special trucks are used to convey the bodies through the booths etc.

In addition to the floor conveyors, a comprehensive system of overhead transport is also installed, there being 4 main conveyors for this purpose.

A " P.C.P.4 " overhead chain conveyor approx. 384-ft. long carries car boot lids and slave equipment from the body-in-black line to the paint finish section. This conveyor, which has one drive and can be varied in speed from 10 to 40 in. per min. passes over the twin body storage conveyors, and is at high level except at the load and unload points; it travels underneath the roof trusses and 45-deg. bends are used to get the conveyor to the load and unload points. The maximum load on this conveyor is 50 lb.

To carry rear attachments and slave equipment from the unload end of the Rotodip plant back to the load end a " 100 P.C.P. " overhead chain conveyor is used. This conveyor has three drives and the speed can be varied from 10 to 40 in. per min. The conveyor is suspended from the roof except at the load and unload points and 45-deg. bends are used to bring the components down from high to low level.

Black bodies are carried to the main paint section by a fixed speed (40 ft. per min.) " Dual Duty " twin-rail overhead chain conveyor 1230 ft. long. The bodies are picked up by means of a body lift section from a floor conveyor and travel approx. 600 ft. when they are lowered by means of a body drop section onto a body truck. There are two drives for this conveyor which has a chain-only compensator and a chain-only weight-loaded tension unit. The maximum load carried is 7 cwt. plus a sill sling of approx. 3 cwt. There is a series of indexers before each drop section. The conveyor is supported from the floor by stanchions and beams at the body drop and lift areas, and roof supported for the rest. This conveyor is 18 ft. 6 in. from floor level to the running flange over the majority of the conveyor.

A similar conveyor, 980 ft. long, carries the painted bodies to assembly. The bodies are picked from a body truck, travel about 400 ft. and are lowered onto the final assembly floor conveyor. The maximum load carried is 7 cwt. plus a sill sling of approx. 4 cwt. There is a series of indexers before each drop section. The conveyor is supported from the floor by stanchions and beams at the body drop, and lift areas, and roof supported for the rest. This conveyor is also 18 ft. 6 in. from floor level to the running flange over the majority of the conveyor.

Finishing Post.

(*Continued from page* 427).

the machine to be varied at any speed between 120 and 1700 components per hour.

6 full adjustable polishing heads type 50/99—10 h.p. are suitably positioned around the table and arranged to cover the component for both scurfing and brushing operations. The contactor gear is contained in a sheet metal cubicle which is positioned some considerable distance from the machine in order to avoid as far as possible ingress of dirt from the grinding operations.

The push button switchgear required for controlling the machine is positioned adjacent to the loading station.

We would be happy to provide further details of this installation to any of your readers who may be interested. Yours faithfully,

R. A. SMITH.
Technical Manager.

B.O. Morris Ltd.,
Coventry.

The Use of SEQUESTERING AGENTS in METAL CLEANING and DEPOSITION

by R. L. SMITH, B.Sc., Ph.D., F.R.I.C.*

THE use of coordination compounds in metal finishing is of considerable proportion and long standing. Cyanide baths represent a most obvious example since it will be generally appreciated that in such baths the metal is in a complexed and not a simple ionic form. There are, however, many less obvious cases in old established practices, while the use of the more recent sequestering agents such as the amino carboxylic acids is considerable and their possibilities extensive.

A general account of the properties of sequestering agents has already been given by Aiken[1]. It is accordingly most suitable instead of repeating a simple introduction of that nature to refer the readers to that article or, for those who wish to study the matter in greater detail, to general articles on the subject[2] or to the present author's forthcoming book on sequestering agents and their uses[3].

Materials which may be considered as sequestering agents find uses in metal cleaning, pickling and alkaline etching processes, while in metal deposition they may be used in three ways ; first, to render ineffective unwanted impurities in the plating bath, second, as the only metal carrier in the bath, and third, in baths of a complex constitution in which it is comparatively difficult to be certain of the full role of the individual ingredients but only of the final result obtained. As the subject of metal deposition is more complicated than the cleaning techniques, it will be most suitable to deal with these simpler matters first before proceeding to consider the complexities of electroplating solutions.

The materials which would now be classed as sequestering agents which have great traditional use in metal cleaning compounds are the group of materials such as citric, gluconic, oxalic and tartaric acids. Their use is so well established in the technology of compounds for cleaning, polishing and plating of metals that for details of their applications the reader may be referred to the various textbooks on metal finishing or to the technical literature of manufacturers[4]. It is here enough to say that all these acids and their salts find application in metal cleaning, pickling and electroplating. Citric, gluconic and oxalic acids or their salts are used in metal polishing ; while citric and oxalic acids alone in this group are used for electroplating, non-electrolytic depositions and electrolytic oxidation.

The use of sequestering agents such as ethylene diamino tetra-acetic acid (E.D.T.A.) can be extremely valuable in obtaining a clean metal surface which is itself a first requirement for any successful metal finishing process. Both metasilicate and polyphosphates have been traditionally used in metal-cleaning processes and E.D.T.A can be used to advantage along with them or on its own, solely in conjunction with caustic soda. Modified forms of E.D.T.A. have been produced for various alkaline processes including de-rusting. One technique is to use the solution in the form of an electrolytic bath at about 60°C. with the metal to be cleaned forming the cathode. Such cleaning solutions present the advantage that they can be freed from iron by plating out the metal, while this is not possible from a cyanide de-rusting bath.

Gluconic and tartaric acids are used in the alkaline etching of aluminium to prevent scale formation of aluminium hydroxide which would retard the process[5]. In somewhat similar manner an etching solution for germanium has been declared to have a composition of oxidizing agents such as nitric acid, hydrogen peroxide, chloric acid, persulphate or hypochlorous acid used in conjunction with a sequestering agent such as oxalic, citric or tartaric acids, tannic acid, E.D.T.A., sucrose, mannitol and ethylene glycol[6]. The sequestering agent E.D.T.A. has also been used in entirely opposite fashion in conjunction with potassium dichromate for corrosion inhibition in acid solutions. It is believed in this case that the sequestering agent by presenting a cleaner metal surface to the dichromate permits more effective absorption of the actual inhibitor[7].

The use of really powerful sequestering agents like E.D.T.A. for the inactivation of impurities in traditional plating solutions must be approached

*Norman Evans and Rais Ltd.

with caution. If the impurity has a higher stability constant with the sequestering agent than has the metal to be plated and is not present in excessive proportions, then by the use of a material such as E.D.T.A. the bath can be brought to a condition as if that impurity were absent. As a general policy, however, this technique must be regarded with caution. Impurities will arise from a given cause and if this cause is not removed, then the inactivation of those impurities already present will not prevent the development of their further presence. It is possible to imagine a case where if a sequestering agent is used as a substitute for cleanliness and good management, that the bath might too rapidly approach a condition where there was an excessive concentration of chelated impurities and an inadequate solubility for the metal and its adjunct materials which constitute the true plating solution. It must, therefore, be the soundest electroplating practice to do everything possible to exclude impurities, as otherwise the immediate relief given by the sequestering agent may only lead to trouble at a later time. However, when all such practical steps have been taken, then the use of such materials can be sound practice.

Plating from Chelate Solutions

Turning now to the use of sequestering agents such as E.D.T.A. in plating baths for the purpose of holding the metal to be deposited, it would be easiest to deal first with baths in which the sequestering agent is the only agent by which the metal is held and afterwards deal with those which are of a more composite character. It is not, however, entirely possible to keep these two classes separate.

The use of E.D.T.A. to hold the metal which is to be plated in solution was first proposed by H. Brintzinger in a German patent in 1941[8]. The baths which he proposed were of an elementary character and while the use of brighteners, conducting salts and anode corroding agents might be held to be inherent in the disclosures, the general detail was inadequate for practical application. The Brintzinger patent suggests alloy plating as well as single metal plating. Its greatest importance is in the limitation it imposes on the novelty of later disclosures. Much more detail in operation without perhaps introducing markedly novel principles is given in a General Motors patent[9]. A most interesting patent is that by Mayer on the electrodeposition of iron[10]. This is of importance because it gives an example of a way of overcoming a difficulty in certain cases in the formulation of such baths which difficulty is not actually stated in the patent and by a method which is not explained as a general principle but only indicated by random examples. The plating baths are alkaline and the chelating agent is E.D.T.A. E.D.T.A. does not on its own chelate ferric iron under alkaline conditions, though this point is not actually stated and various other ingredients of the bath achieve the solution of the iron by the formation of mixed chelates. The extra ingredients recommended appear to have been obtained by trial and error but any other additives which assist E.D.T.A. to form mixed chelates stable under alkaline conditions or any materials normally related to E.D.T.A., which do by some variation of chemical structure achieve the same result in chelates solely between the metal and a single molecule or ion might produce the same end result.

It is interesting to compare this patent with the work of Davies and Angles[11] on the electrodeposition of tin and zinc alloys from baths which nominally contain zinc in chelate form and tin in the stannate condition. They found it necessary to use hydroxyethyl ethylene diamine triacetic acid since with E.D.T.A. a precipitate formed in the vicinity of the anode. This was ascribed to the precipitation of E.D.T.A., which, however, could only occur at a *p*H of about 1 and was therefore unlikely to take place around the anode in a bath containing 5 gms. per litre of sodium hydroxide above the akallinity represented by sodium stannate. It is more probable that the *p*H drop around the anode results in a value of about 12 where the insoluble E.D.T.A. chelate of tin would begin to form. Hydroxyethyl ethylene diamine triacetic acid on the other hand forms soluble tin chelates which would therefore not precipitate around the anode. Solubility of the E.D.T.A. tin chelate can be achieved, however, by the addition of citrates or tartrates resulting in a mixed chelate. Thus additional coordinating agents may be required either to achieve greater stability of chelate or greater solubility of the chelate, though either of these factors may in appropriate cases be achieved by selection of another member of the amino carboxylic acid family of sequestering agents. To enumerate all the varieties of chemical now possible in this class would be too lengthy in this article and the reader must be referred to more general treatments of this branch of chemistry[3].

The plating of gold alloys has been claimed by Spreter and Mermillod[12] with baths in which the gold is held as a cyanide complex but without excess of cyanide and the other metals as E.D.T.A. chelates, while the normal conducting salts of the cyanide gold alloy baths such as phosphates and sulphites are replaced by excess of the alkaline salts of E.D.T.A. Such baths are claimed not to deteriorate through age and to retain a high rate of deposit.

Satisfactory anode corrosion is most important in any electroplating bath. Various patents have claimed the intentional addition of anode corroding agents such as citrates and tartrates, while baths

of chelated metal often contain ions such as sulphate and chloride due to the salts used in making up the initial baths. A recent Geigy patent[13] covers the use of hydroxyethyl ethylene diamine triacetic acid as sole complexing agent, giving as a particular advantage good anode corroding properties resultant from the use of this material. However, commercial success has been obtained by others with the use of E.D.T.A. and other solely amino carboxylic acids in plating without addition of extra and specific anode corroders.

The survival of comparatively expensive chelating agents during the process of electrodeposition is of importance both from reason of cost and to maintain a bath free from impurities. The results of Davies and Angles, strictly interpreted, suggest an actual electrolytic deposition of chelating agent of 56 per cent. during the period of operation of the bath. If this should be the case it would be serious, but some doubt on the reliability of this conclusion, which may nevertheless be legitimately drawn from their description, has been expressed to the writer by other workers in this field. The disclosures of technique of chelate plating having been mainly in the form of patents have been able to avoid mention of chemical survival of the chelating agent. It might be argued that the *p*H drop at the anode would cause a deposit of E.D.T.A. liable to oxidation. As, however, electromigration does not assist in the transport of coordinated metals on account of the reversed ionic charge, mixing must at all times be achieved by stirring. The same factor of good agitation correctly applied should assist both the effective concentration of available metal at the cathode and prevention of the condition which might give rise to deposition leading to oxidation degradation of the chelating agent at the anode.

It is generally most satisfactory to plate from chelate solutions at a high temperature, say 70°C., though in some cases it is practical to work at much lower temperature. There is at present no explanation to account for this difference of behaviour. Copper can be immersion plated from its E.D.T.A. chelate solutions and this can be a complication in controlled electroplating of that metal from a bath of this character.

Chemical Deposition of Nickel

Two recent patents[14] deal with methods of chemical plating of nickel by means of the decomposition of hypophosphite ion to phosphite ion accompanied by the evolution of hydrogen. The metal is carried in solution as its chelate. Decomposition of the hypophosphite is catalysed by the metal surface to be plated and the nickel actually plated. The chelating agents which increase the catalytic effect are described as " exalting agents " and it would appear probable that it is actually the chelate of the metal and not the metal ion which is the catalyst. In the second of these patents a distinction is drawn between " exalting agents " and " complexing agents." In fact the materials used in both categories are complexing or chelating agents and the distinction appears to be that the same agent does not necessarily produce the best catalytic chelate and also behave as the best carrier for the metals to be deposited. The process described will be more understandable when it has been restated in more conventional terms than those which it has been found possible to employ in the patent specifications. In the meantime it indicates that the number of forms of plating involving chelation as a means of holding the metal which is to be deposited must now be expanded to three, namely, electroplating, solution plating and catalytically induced plating of metals held in chelate form by chelate catalysts.

The field of electroplating has always been rather more of an art than a science and it is difficult even today to explain fully the conventional plating solutions in chemical terms. It is therefore not surprising that a rather incomplete picture can at present be drawn of the mode of use of chelating agents in the plating solutions. There must by now be a considerable body of practical knowledge in the field which, however, is disclosed in as small measure as its operators can achieve. At the same time also because the chemistry of plating solutions is so imperfectly understood, it is difficult even with the quite extensive knowledge now available on the properties of chelates to forecast the behaviour of these materials in practical electroplating. The writer has therefore had to comment on factors which can be of importance since it is not possible to give full and detailed instructions of processes.

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A New Approach to THE ELECTROSTATIC DEPOSITION OF PAINTS

described by T. A. DICKINSON

ELECTRONIC coating equipment recently introduced by Baron Industries of Los Angeles, U.S.A. permits the fully-automatic application of low-viscosity finishing materials to a variety of products in large or small quantities with standard spray-booth facilities.

In essence, the operation of this equipment is based on the electrostatic finishing principle—its purpose being to ionize sprayed coating particles in a high-voltage electric field, so that the particles will be attracted to conveyor-grounded product surfaces. However, it is a method of utilizing the principle that is new as well as advantageous.

The ionizing electrodes comprise metal tubes, each with a series of fine projecting points, instead of a sequence of wires. The reason for this is given below.

Since metals are electropositive elements in general, they are characterized by atoms which may readily lose one or more electrons. These relatively mobile electrons exist in a constant state of dissociation from the atoms and may be caused to drift through the metal under the action of applied electric forces, thus forming the ordinary conductive current.

When additional energy is added to the metal (from mechanical, electrical, thermal, or photo-optical sources), some of the unbound internal electrons may be given enough energy and sufficient velocity in the direction of the surface of the metal to escape the potential barrier which normally holds them within the metal. When such electrons free themselves, they are said to be thrown off by *electron emission*—a phenomenon characterized by the source of energy as thermionic, photoelectric, secondary (mechanical), or field (electrical) emission. Electron emission in one or more of these forms is necessary if electrons are to pass from an electrode into space for subsequent collection by another electrode.

The spontaneous discharge from the 'emanating' electrode in the subject system is known as field (or cold) emission. The configuration of electrodes is important in the production of 'cold' emission because it is necessary to raise the electrical stress in the surrounding dielectric (air) above a critical figure before any reaction takes place. The cold emission is known as corona discharge or Townsend discharge and is accompanied by a luminous phenomena which is visible only in a dark room.

The corona discharge appears on very thin wires, sharp points, or sharp edges. Only with very thin and very clean wires can a uniform discharge be maintained along the entire wire and a uniform current generated therefrom. When wires like those used in conventional industrial practice are in use, more or less isolated discharge points are eventually formed. These points are produced by burrs or points on the wire, microscopic roughness of the metal surface, or surface contaminants ; and, of course, they are subject to numerous deviations with reference to their locations from time to time.

Tubular electrodes, on the other hand, establish permanent ionizing points (since sharp edges on the tubes serve the same purpose as extremely fine wires) and have much greater mechanical strength.

A strong electrical field is produced between each ionizing electrode and the grounded ware with the new equipment by impressing as many as 100,000 volts d.c. on the electrode. Sharp points on the electrode strengthen field intensity and create the electrical discharge required to ionize the molecules of air in the vicinity of the points. Positive ions of air are then collected by the electrode, while negative ions are driven across the air gap in the direction of the grounded ware under the action of the voltage gradient.

The flow of negative air ions occurs independent of the spray painting operation. Current flow depends on the size and construction of the electrodes, surface area of the ware, spacing and surface area of the electrodes, and impressed voltage. Therefore, the number of spray guns used and the volume of atomized paint in the air has little effect on the electrical characteristics of the system.

Rapidly-travelling air ions are driven in a kind of beam from the individual discharge points to the grounded ware ; and, when the intervening air is filled with small atomized paint particles, colllision of negative air ions with the coating particles causes the latter to become negatively

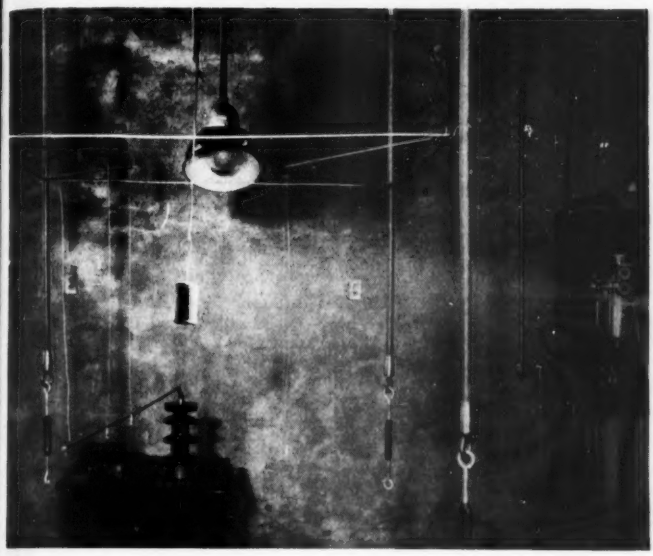


Fig. 1.—Conventional electrostatic finishing set-up uses fixture-mounted gun or guns and fine wires to polarize aerosol particles. Cylinder suspended at left is gun's target in this set-up, which was arranged for demonstration purposes.

charged. Thus, an essential factor in the efficiency of the equipment is the maintenance of a maximum difference in voltage between the ionizing electrode and the grounded electrode. This is determined by electrode spacing, electrode design, and electrical wave form.

The charge on the paint particles in ionized air increases very rapidly at first, then more slowly. The increase finally becomes so slow that, even if the particles could be kept in the field for several hours, no change in the charge would be observed. This critical charge is almost a linear function of the radii of the particles and depends to a degree on the ion density. A doubling of the critical charge can be accomplished by increasing ion density about 100 times. The charge on the particle will constantly grow due to the stream of ions impinging on and adhering to the surface of the particle ; and, as the charge on each particle increases, a gradually-intensified repellent force will be exerted on other approaching ions, thus limiting the charge on each particle.

Once the paint particle becomes charged, the repulsive force of the electrode and the attractive force of the ware precipitates the particle on the ware.

Along with the precipitation of particles due to the electrical field, there is another sustained locomotion due to the "electrical wind" currents. Rapidly-moving air ions, driven in a beam from emitting points of an ionizing electrode toward a grounded product surface, intrain ambient air and coating particles suspended therein, accelerating movements of the particles by intensifying the effects of purely electrical forces.

Because of the continuity of the air flow, and because of its deflexion and rebound when it approaches the ware, vortex formations (which may be seen if adequately illuminated) are produced; and, in this connexion, it is interesting to note that the action of the " electrical wind " currents is very similar to the action of atomizing air currents.

Standard pneumatic spray guns of the type that can be used to atomize virtually all liquid coating materials may be fixture-mounted, individually or collectively, for use in connexion with the new electronic finishing process. Numerous types of mounting fixtures for the guns can be quickly made to order in conformity with specialized finishing requirements, and as a rule the alignment of each fixture is such that the output of each gun will be aimed at right-angles to the surfaces of the products that must be coated.

The perpendicular alignment of spray guns and work is by no means a standard practice in the use of conventional electrostatic finishing equipment ; but, according to the company, this greatly reduces the number of coating particles that would otherwise be wasted by making it necessary for the particles to travel parallel to the electrical force lines. When particles are sprayed from a different angle, it is explained it is necessary to alter the direction of the spray so that it will reach a given deposition surface, all of which necessitates the use of a longer electric field and creates a dispersion effect (due to turbulent exhaust currents), causing substantial quantities of coating particles to be lost as the result of drying action and undesirable applicational forces.

An especially interesting aspect of the new electronic finishing equipment is the fact that it enables a deposition surface to serve as a sort of baffle plate in capturing atomized coating particles. If a particle is not applied immediately, it must be deflected 90 deg. or more before it is lost ; and, since the velocity of a particle is greatly reduced when its direction is changed, there is a very good

chance that deflected coating materials will eventually reach a deposition surface due to the action of continuous electrical forces.

Low atomizing pressures tend to supplement the latter forces in reducing particle losses due to rebound ; and, where the distance between a spray gun and the work is regulated so as to minimize overspray losses, the deposition efficiency of the electronic equipment may exceed 90 per cent by a sizeable margin.

Power for the ionizing electrodes is derived from a 110-volt, 60-cycle alternating circuit by means of a high-voltage transformer and a full-wave electronic rectifier. The purpose of the full-wave rectifier is to produce the required direct current without utilizing as much alternating power as does a conventional electrostatic finishing unit (which has a half-wave rectifier).

A vacuum tube in the main power circuit halts all finishing operations when there is a substantial surge of amperage in the electronic equipment, since too much amperage invariably denotes a dangerous sparking condition ; and the possibility of a fire or accident is slight, even if the safety tube should fail, because the design of the equipment is such that all components must function properly before finishing operations can take place.

The electronic power supply is portably housed and can be operated by means of a plug-in attachment on any 110-volt alternating power line.

Where it has been necessary to use the new equipment in finishing articles which could not be closely spaced on a conveyor, an automatic tripping mechanism has been installed for the purpose of conserving coating materials. The function of this mechanism is to turn the spray guns of at times when there are no products to be finished directly in front of the output nozzles.

Special rotation fixtures have also been used on conveyors where it was possible to finish two or more surfaces of a product in one automatic spray operation.

Products that have to date been coated by means of the new electronic equipment include steel pails, blitz cans, metal chair frames, automatic washer and dryer housings, petrol engine components, steel cabinets, artillery shells, steel pipes, etc. Finishing materials included porcelain enamels, baking enamels, lacquers, oil paints, water dispersions, etc.

As indicated by Figs. 1 and 2 some touch-up work has been required where the intricacy of a product caused certain deposition areas to be inadequately accessible to the automatic spray guns ; but, in virtually all cases, areas requiring manual touch-up work amounted to less than 5 per cent of the overall surface areas that were actually finished. Further, because the total electronic spray zone has rarely occupied more than 42 sq. in. of space, it was usually possible to accomplish such work in the same booth that was used for automatic finishing operations.

Savings in terms of coating materials have ranged from about 30 to 70 per cent and rejects due to defective finishes have been reduced by a margin of at least 10 per cent where the new automatic spray equipment was consistently used for an appreciable length of time. Labour requirements were approximately the same as could be expected in conventional electrostatic finishing operations where a single coating station was utilized, but in some instances both labour and power costs could be reduced by using a single power pack to energize electrodes and related facilities at two or more coating stations.

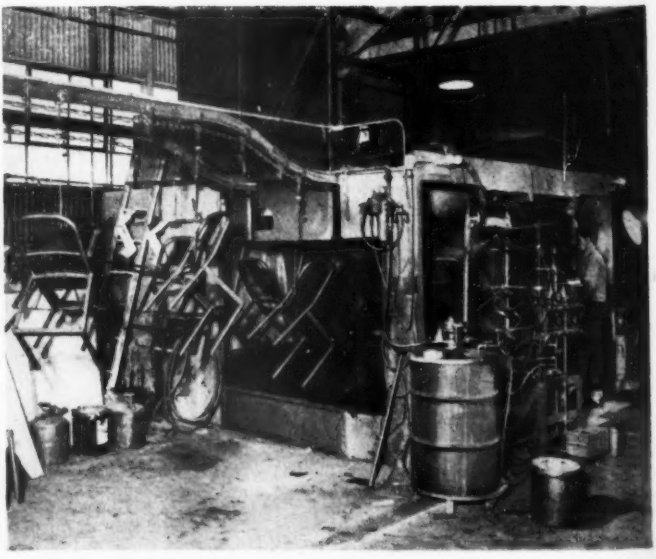


Fig. 2.—Conveyor-borne chairs entering spray booth at left. Operator at right is touching up chairs that have been coated by fixture-mounted guns (behind paint-storage tank) in foreground.

A Quarterly Survey of some of the Features in Finishing Literature from Abroad

by SCRUTATOR

Corrosion

WHICH towns in this country and in the United States have the worst atmospheres from the point of view of rate of attack on unprotected mild-steel surfaces? To those fairly familiar with corrosion and metal-finishing literature the names which immediately spring to mind are Sheffield and Detroit. The former because of the findings of Hudson in his work for the Corrosion Committee of B.I.S.R.A. and the latter because one so often reads about the heavy corrosion of plated motor-car bumpers in Detroit. The Sheffield atmosphere may or may not be extremely corrosive but according to a recently published Americans urvey, Detroit is definitely not one of the four American towns with the highest corrosion rate[1]. These are Buffalo, Rochester N.Y., Erie and Miami. This conclusion was reached as a result of tests carried out over the past 25 years by the Rust-Oleum Corporation in which uncoated 10-in. x 5-in. x 28-g. bare steel panels have been exposed in 523 American Cities with a population of ten thousand or more. As a result of this work it is estimated that corrosion costs America 7½ billion dollars per year. Corrosion damage in and around the home accounts for 1¼ billion dollars and costs to the United States Navy and American Railroads are 500 and 100 million dollars respectively.

For those interested in rather more scientific corrosion tests, Wolff[2] has reported the results of tests in which periodic observations were made of the weight changes of zinc-plated steel panels, with and without a supplementary chromate treatment under conditions of 20 per cent salt spray or outdoor exposure. It was found that the weight change of untreated zinc increased to a maximum at a uniform rate dependent on conditions and decreased after the maximum at the same approximate rate. The weight changes for the chromated zinc varied slightly during the period of maximum weight for untreated zinc and then decreased at the same rate. The chromate film suppressed the formation of bulky corrosion products and approximately doubled the exposure time to the first signs of rusting. The appearance of the chromated zinc was better than untreated zinc in both tests.

Plating

With the possible exception of the plater, nothing in the plating shop is taken more for granted than the water which is used in such large quantities in the plating solutions and processes. Admittedly more attention is now being given to disposal of the water after it has been used, *i.e.* " the effluent problem ", but far too little thought is given to the advantages to be gained from conditioning water for use in electroplating and metal-finishing treatments. Spencer[3] in an extremely useful survey has reviewed the effects on plating of the various impurities which may be present, describes methods which can be employed for conditioning water and has also outlined some of the possibilities for recovering treatment chemicals from the rinse waters.

Similarly, most plating shops which are connected, however remotely, with the light engineering industries contain a nickel-plating bath and this is, almost without exception, an acid solution. Saubestre[4] has studied the deposition of nickel from alkaline solutions and has used equilibrium data for various complexing agents to calculate deposition potentials for nickel. He concludes that polyphosphates and ammonia are suitable inorganic complexing agents and suitable organic materials include dibasic carboxylic acids, α-hydroxy carboxylic acids, etc. Examples are quoted from the literature of alkaline nickel-plating solutions and his experiences of modifying an electroless nickel-plating solution by eliminating hypophosphite and using current are described.

Up to a few years ago the principal interest and demand for gold plating was in the decorative field—costume jewelry providing the largest outlet. Due to the demands of the electronic communication and control equipment industries, interest for gold plating has been revived and stimulated. At first the demand was for pure gold because its electrical conductivity was almost as good as that of silver but it had none of the tarnishing problems. As development progressed so gold alloys were required to be electrodeposited for service under specific conditions. Recent developments in the plating of alloys of gold with antimony, indium, nickel and silver with specific reference

(*Continued in page* 440)

A NEW BLACK NICKEL Plating Process

Introduction

THE colouring of nickel by the electrodeposition of a black layer is useful in producing a decorative effect which can be very attractive. In addition, such a coating may have properties which may be put to more technical advantage ; for instance, as a means of minimizing reflected glare from office or laboratory equipment and improving heat radiation characteristics of a surface.

A solution, typical of those currently used for electrodeposition of black-nickel, has the following composition :—

Nickel sulphate ($NiSO_46H_2O$)	75 gm. per litre
Nickel ammonium sulphate ($Ni(NH_4)_2(SO_4)_26H_2O$)	45 gm. per litre
Zinc sulphate ($ZnSO_47H_2O$)	37 gm. per litre
Sodium thiocyanate (NaCNS)	15 gm. per litre

The solution is operated at a *p*H of 5.6 to 5.9, a temperature of 120 to 130°F and a current density of 5 to 20 amp. per sq. ft.

Many users of such a process report that thick deposits cannot be used because of low ductility and lack of adhesion. Thin deposits in turn give low abrasion resistance since the coating is soon worn through. Furthermore, the solution composition and operating conditions must be controlled within quite narrow limits to obtain the best colour; platers often complain that grey and patchy deposits are more the rule than the exception.

The New Process

With these limitations of the existing process in mind, investigations, carried out in the Bayonne Research Laboratories of the International Nickel Company Inc., New York, were made with the object of improving the ductility, adhesion, abrasion resistance and colour of the black-nickel deposit. A new solution, from which deposits with greatly improved properties can be obtained, was evolved. This invention is covered in the United States by Patent 2,844,530 (W. A. Wesley and B. B. Knapp) and corresponding patents have been granted or are pending in other countries, including Australia, Belgium, Canada, France, Germany, Holland, Italy, Japan, Sweden, Switzerland and United Kingdom.

In the course of the investigation many ideas, some new, others based on the results of previous work, were tried out. Of these, the substitution of chlorides for sulphates in the existing solution gave improved properties in the deposit. By varying the concentrations of the individual constituents of the solution, the composition giving an optimum combination of colour, adhesion, and ductility was determined. The composition is given below with permissible concentration ranges in brackets. The nickel-chloride, content which is more critical than the others, is discussed in the following paragraph.

The Solution and Operating Conditions.

Nickel chloride ($NiCl_26H_2O$)	75 gm. per litre
Ammonium chloride (NH_4Cl)	30 gm. per litre (7.5 to 45 gm. per litre)
Sodium thiocyanate (NaCNS)	15 gm. per litre (7.5 to 30 gm. per litre)
Zinc Chloride ($ZnCl_2$)	30 gm. per litre (15 to 60 gm. per litre)
*p*H	5.0
Temperature	Room
Current density	1.5 amp per sq. ft.

Effect on the Colour of the Deposit of Changes in Solution Composition, and Operating Conditions :

Variations in the concentration of ammonium chloride, sodium thiocyanate and zinc chloride within the ranges indicated above had no deleterious effect on the deposit and good black coatings were consistently obtained. This flexibility contrasts remarkably with the old sulphate solution where concentrations are extremely critical.

The nickel-chloride content is, however, more critical and it was found that high concentrations (100 to 150 gm. per litre) require higher current densities (3.0 to 6.0 amp. per sq. ft.) to achieve dense black coatings. This limitation is by no means always disadvantageous, since at low current density a minimum plating time of 15 minutes is required to obtain a black coating; shorter times give films so thin that interference colours are seen. Higher current densities will give black deposits in proportionately shorter times.

From Fig. 1 which illustrates this relationship between current density and nickel chloride concentration, it may be seen that the range of suitable current density widens as the nickel content is increased.

Changes in *p*H within the range 2.3 to 5.5 do not affect the colour of the deposit.

Physical Properties of the Deposit.

If plating is carried out in accordance with the conditions already stated, a dense black coating is obtained, which may, if desired, be made more attractive by a light buffing with grease. Etching the basis metal to give a matt surface will result, on the other hand, in a matt jet-black coating which would be suitable for applications (*e.g.* photographic equipment) where reflexion of light must be at a minimum.

Abrasion, Adhesion and Ductility :

Data derived from tests on the new black-nickel deposits showed them to have better abrasion resistance, adhesion and ductility than deposits from the existing sulphate solution.

In the abrasion test a rubber pencil eraser, fixed in a drill chuck and in contact with the coated test panel with sufficient pressure just to deform the rubber, was rotated at 625 r.p.m. The time (in seconds) needed to wear through a coating of given thickness was taken as a criterion of abrasion resistance, and many panels withstood this test for 20 seconds without break-through.

Adhesion and ductility were both determined qualitatively by bending a coated panel through 180 degrees over a radius of $\frac{3}{16}$ in. to $\frac{1}{4}$in. The adhesion of the black-nickel deposits was greatly improved by pre-treating the basis metal (either wrought or electrodeposited nickel) in the acid all-chloride nickel strike bath, similar to that used to obtain adherent deposits on stainless steel.

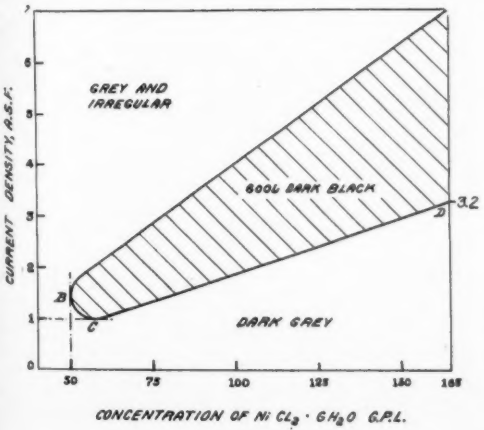
Effect of Basis Metal Preparation and Operating Conditions on Physical Properties of Black Deposits :

To evaluate the influence of surface preparation on the adhesion of the deposit, wrought-nickel or nickel-plated specimens were subjected to various pre-treatments prior to black-nickel plating. From the results of bend tests it was concluded that the most effective pre-treatment for optimum adhesion is cathodic alkaline cleaning, followed by the acid-all-chloride nickel (anodic/cathodic) strike. Sulphuric or hydrochloric acid dips prior to black-nickel plating gave a lesser degree of adhesion.

Use of the acid, all-chloride nickel strike is also necessary for plating prior to the deposition of black-nickel on to stainless steel or other chromium-containing materials.

Variation of *p*H within the range of 2.3 to 5.5, and of current density within the range 0.75 to 1.5 amp. per sq. ft., had no effect on abrasion resistance and ductility. Plating for times of 30 to 60 minutes within the above range of current densities resulted in thick deposits with excellent abrasion-resistance but with somewhat lower ductility. Adhesion of these deposits also was improved by subjecting the basis metal to an acid, all-chloride nickel strike.

Fig. 1.—Effect of variations in current density and nickel concentrations on black plating range



Corrosion Resistance :

After exposure for one year to an industrial atmosphere, test specimens, unprotected except for a coating of black-nickel deposited either from the conventional sulphate solution or the new chloride solution, all suffered loss of colour and deteriorated to a mottled grey. Similar black-nickel coatings exhibited no additional protective capacity when applied to nickel-plated steel panels. A top-coating of lacquer is, therefore, recommended where a black-nickel-plated component is to be used under corrosive atmospheric conditions. (Lacquered test panels showed neither deterioration in colour nor signs of corrosive attack after one year's exposure). Black-nickel deposits from either the new or conventional solutions should be used without a lacquer protection only in mild indoor atmospheres. Where the component is fabricated in steel, it is in any case advisable to nickel plate before applying the black coating.

Conclusions

A new chloride solution is recommended for electrodeposition of black-nickel deposits which, in appearance, are invariably as good as the best deposits obtainable from the conventional sulphate solution. The new solution is easier to operate because of the wide ranges of composition, *p*H and current density within which it is possible to obtain good results.

The coating is adherent and has, moreover, considerable abrasion resistance and a ductility superior to that of deposits hitherto obtained.

Its corrosion protection powers are limited, and for outdoor service a top coat of clear lacquer is recommended.

Some Observations on THE FORMATION OF OIL PORES in Nickel Electrodeposits†

by K. SOMMER*

TO produce faultless, electrolytic deposits of metal, the cleaning of the parts to be treated is of extreme importance. This fact has been clearly recognized for decades, and numerous references to it can be found in the literature on the subject. Comprehensive articles, with far-reaching surveys of the literature, have been written, for example, by Machu[1] and Gray[2]. Also in recent years, methods for cleaning metal surfaces such as degreasing, etching, pickling, washing etc., have been discussed in detail. Nevertheless, it is proposed here to report on a special phenomenon which should be of major importance to the practical man, and which has hitherto not been frequently referred to. This phenomenon is a type of pore formation in electro-deposits, caused by the effects of fluid oil or grease.

With oil or grease residues on a surface to be plated, the property of adhesion is affected mainly, and there are patchy, unsightly areas formed which render the components unacceptable. It is apparent that grease-containing materials adhering to the work (polishing and grinding material) or adherent water-repelling particles, prevent deposition of the metal, as there is no local contact between the electrolyte and the work. This trouble with oils and greases will not be gone into further here. Rather, it is intended to deal with serious troubles arising through fluid oil or grease, particularly in the nickel plating of steel and brass. Odekerken[3] gives various reasons for the occurrence of porous deposits and points out, among other things, that badly cleaned articles tend to form pores locally when they are coated with grease. The incidence of pores, and their causes, may now be more clearly explained by an example from practice.

A firm engaged in bright nickel and chromium plating of hollow, tubular articles, carried on this work for quite a long time without trouble. The plating cycle was as follows :

1. Electro-cathodic degreasing (hot).
2. Rinsing in water.
3. Pickling in approx. 10 per cent sulphuric acid
4. Rinsing in water.
5. Nickel plating in bright nickel bath.

Then followed chromium plating carried out in the conventional manner. In the course of time, oil or grease leaking from the inside of the components collected in the pre-treatment baths and in places covered the surfaces of the work. After thorough rinsing, no adhering oil or firmly attached particles of dirt could be detected by thorough inspection after degreasing. The nickel plating, however, at widely varying places was extremely porous, as Fig 1 shows : the pickling bath was covered with a thin film of slightly iridescent oil. Also in the degreasing bath, oil could be detected on the surface. After completely removing the oil, the defect in the nickel deposit disappeared. From this it is to be concluded that it is not a matter of so-called fatty saponification. Attention must necessarily be paid to the elimination of oily pollution, which can be carried out, for example, by pre-cleaning with trichlorethylene or perchlorethylene or by degreasing by boiling or multistage hot electrolytic degreasing, in order

Fig. 1.—*An oil pore in a nickel coating seen from above clearly showing the parallel stepped structure at the periphery.* x 150.

†Based on a contribution to the Distributors Conference, 1957, organized by the Electro-Chemical Engineering Co. Ltd.

*Friedr. Blasberg G.m.b.H.

Fig. 2. (right). A section through an oil pore showing the stepped structure at the edges and the scattered nickel nodules in the centre. The white areas are nickel. x 150.

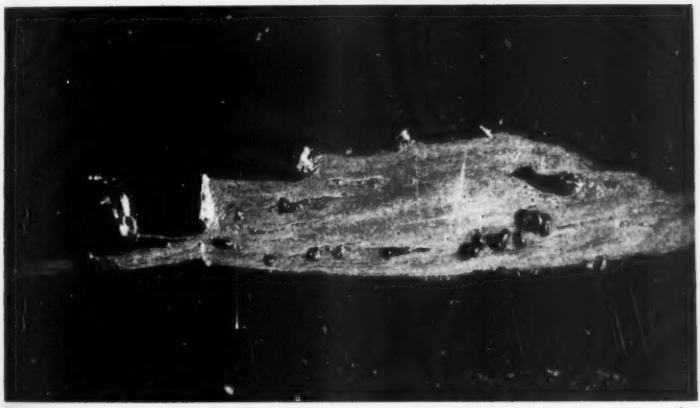


Fig. 3. (left). An irregular and elongated pore-showing sharp angles at the edges and scattered individual nodules of nickel in the centre.

to eliminate the fault permanently. It is of importance also to keep the pre-treatment baths overflowing, with oil-separating compartments. Water rinses should be provided, with an overflow in slot form instead of the usual outlet pipe. Modern degreasing and pickling baths should take into consideration these factors of design. Spray rinsing also conduces additionally to improved cleaning of the work.

Description of the Oil Pores.

The size of the pores varies widely, from some which are only visible to others which may be some centimetres in length. Sometimes the pores are also found grouped in a line usually pointing to the surface of the bath. The form may be practically circular, but may also be very irregular and much elongated (Fig. 3). They sometimes have sharp angles, particularly at the edge. Fig. 1 shows a pore seen from above, and it is very noteworthy that a number of parallel rings can be observed. The valley of the pore is only partly coated with nickel, and in the present case the basis material, steel remains exposed. The individual elevations in the middle of the pore, which consist of nickel, may be of interest. An elevation can be clearly seen in the sectional view, Fig. 2.

The above-mentioned rings, moreover, are arranged in stepped form, which can also be seen in the section. The individual steps have sharp-edges so far as can be determined microscopically. In Fig. 2 the white spots are nickel. Before preparing the ground section, the pore was electrolytically embedded in copper.

The author is still unable to explain the rings : moreover, these rings could not be observed in all cases.

(*Continued in page* 440)

The Formation of Oil Pores

(*Continued from page* 439)

Gray[2] on page 37 of his book shows a hydrogen pore with concentric rings, which he attributes to the formation and bursting of hydrogen bubbles. As Figs. 1 and 2 relate to a bright nickel plate, the rings may also be associated with the so-called lamellar structure of many bright nickel deposits. Perhaps also reciprocal reactions between oil and electrolyte play a part in the formation of the annular steps.

It is worthy of mention that the adherence of the nickel coat to the whole article could only be described as good and the only defect was that observable in the form of pores.

Figs. 1 and 2 are at a 150 x magnification and the thickness of the nickel coat is approximately 30 microns.

Oil pores have been observed so far, not only in the direct nickel plating of steel, but also in the nickel plating of brass, and in one case even when an approximate 0.5 micron undercoat of copper had been applied. When chromium plating, the uncovered depressions were also not coated with chromium. This was repeatedly found to be the case when the process was closely observed.

It is to be assumed that the oil pores under the conditions described form mainly in acid baths, and that oil pores are less to be reckoned with in alkaline electrolytes on account of the degreasing action of the latter. Obviously the introduction of oil into the plating solutions must be avoided in order to prevent contamination of the electrolyte.

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1. Machu, Oberflachenvorbehandlung von Eisen und Nichteisenmetallen (1954).
2. Gray, Modern Electroplating (1953).
3. Odekerken, Pitting of Electrodeposits, *Metal Industry*, September, 1956.
4. Morgan, *Monthly Rev. Am. Electroplaters' Soc.*, 34 (1947), p. 430-441.
5. Harris, *Proc. Am. Soc. Testing Mater.* 45 (1954), p. 997-1014.

Overseas Review

(*Continued from page* 435)

to applications in the transistor, connector and printing circuit field have recently been described by Parker.[5]

Painting

One of the main problems confronting paint laboratories is to find a reproducible method of applying wet films of specified uniform thickness to test panels. This whole subject has recently been reviewed by Gardner[6] and most of the currently available types of film applicators are critically discussed. Bardin[7] has given some details of painting on quite a different scale, namely the finishing of 1000-ton presses as manufactured by the Clearing Machine Corporation. These presses are 45 ft. high 18 ft. wide and 10 ft. deep and weight about 500,000 lb. They are primed, putty glazed and top-coat enamelled in the open shop. As hand brushing would take too long and be too tedious and costly, airless spraying is used and this is claimed to be so efficient from the point of view of lack of overspray that floor operations can be carried out near the press being painted. Fifty foot hoses are used. In this connexion the Douglas Aircraft Company[8] have recently published details of their method of airless spraying which allows them to use lines up to 150 ft. long.

In essentials their finishing lines have 3 channels, of which two circulate hot water round the third thereby keeping the paint warm and fluid. They maintain that this overcomes the trouble of clogged hoses which hiterto forced them to work with short lines.

(1) *Iron Age*, 1958, **182,** (9), 54-56.
(2) *Metal Finishing*, 1958, **56,** (6), 46-52.
(3) *Metal Finishing*, 1958, **56,** (7), 44-51.
(4) *Plating*, 1958, **45,** (5), 479-485.
(5) *Plating*, 1958, **45,** (6), 631-635.
(6) *Ind. Finishing*, 1958, **34,** (10), 48-55.
(7) *Ind. Finishing*, 1958, **34,** (8), 66-68.
(8) *Steel*, 1958, **143,** (3), 117.

IMPROVING THE FINISH OF TINNED WARES

A small but important problem encountered in hot tinning is that, as the molten tin drains from articles just removed from the tinning pot, it may form thick droplets or ridges at corners and edges of the tinned wares. Such excrescences not only give an uneven finish but are also a waste of tin. One way of removing unwanted tin, whether in the form of droplets or of excessive overall thickness, is to transfer the articles straight from the bath of molten tin into a bath of oil at nearly the same temperature, thus allowing draining to take place much more slowly and evenly.

A much more satisfactory method of removing the surplus molten tin, which has steadily been gaining favour in the past few years, is to take advantage of the high density of the molten tin by using centrifugal force.

The Autumn number of *Tin and its Uses*, the quarterly journal of the Tin Research Institute contains an article describing experiments recently carried out in the Institute's laboratories to examine the effect on tin coating thickness of centrifuging time and speed of rotation in the hot-tinning of steel frying pans.

FINISHING NEWS REVIEW

TECHNOLOGY COURSES

AN intensive 3-week course will be held at the department of mechanical engineering of the Imperial College of Science and Technology from April 20 to May 8, during which the most important technological theories and researches underlying the major metal-working and machining processes will be considered. The course is intended for graduates in engineering, physics, or mathematics who are concerned with production processes and either require a refresher course in the principles of metal-working or have little or no knowledge of the subject. Many of the lectures will be given by experts from industry.

A more detailed announcement will be made in the technical press at the beginning of 1959, although further details and application forms can be obtained now from the Registrar, Imperial College, London, S.W.7.

Plating Show

IN previous years, the exhibit displayed by W. Canning and Co. Ltd., Great Hampton Street, Birmingham, at the Cycle and Motor Cycle Show has comprised various plating and polished processes of use to the industry. This year, however, the company are featuring displays of plated components produced by cycle and motor cycle manufacturers. By this method it is hoped to show the type, standard and quality of the nickel and chromium finishes obtained by normal production methods using Canning equipment and materials. Specimens have been supplied by many of the leading manufacturers.

PLASTICS SALES DOWN

B. of T. Report Indicates Drop in 1958

SALES of plastics materials in the second quarter of this year were 97,900 tons or nearly 2 per cent below the second quarter of 1957, according to a report issued recently by the Board of Trade. Although sales have now fallen below those of a year ago, they are still well above those of 1956. Because of the stock build of plastics materials in the second quarter of this year, the estimated rate of production remained high, and was about 4 per cent above a year earlier.

Sales of thermosetting materials at 42,100 tons were 2 per cent lower than a year earlier and the rate of production was also down about the same amount.

Sales of thermoplastic materials at 55,800 tons were about 1 per cent below a year earlier; however there was a fairly large stock build in the second quarter and production was maintained at about the same high rate as in the previous six months, and well above that of a year earlier. Stocks of polystyrene moulding and extrusion compounds increased in the year by 1,100 tons (to nearly 5,000 tons); in polyvinyl chloride materials (other than resins) stocks of moulding and extrusion compounds increased in the year by 400 tons (to 2,500 tons) though in the more highly finished materials the overall stock changes were not large.

DUKE'S PRIZE FOR ELEGANT DESIGN

THE Council of Industrial Design have announced the establishment of The Duke of Edinburgh's prize for "elegant design."

The award, to be presented annually, will be for "a contemporary design in current production distinguished by its elegance," from among products that have been displayed in The Design Centre, Haymarket, London.

The panel to choose the 1959 winner from among the products exhibited during 1958 is made up of Lady Casson, A.R.I.B.A., Miss Audrey Withers, O.B.E., Mr. Basil Spence, O.B.E., F.R.I.B.A., F.S.I.A., Sir John Summerson, C.B.E.

The prize can be chosen by the winning designer to a value of a £100 and will carry a suitable inscription.

I.V.E. Midland Dinner

THE annual general meeting and dinner of the Midland branch of the Institute of Vitreous Enamellers will be held at the Station Hotel, Dudley, on January 30. Tickets can be obtained from the Secretary, Mr. D. Sleath, at 17 Stratford Road, Warwick.

SUMMER SCHOOL

EIGHTY-ONE delegates assembled in Stoke-on-Trent for the summer school organized by the Institute of Vitreous Enamellers at the end of September.

On the Friday, a works visit was made to Simplex Electric Co. at Blythe Bridge. During the technical sessions held on the Saturday, the following addresses were given: "Electric Fusing Furnaces," by Mr. T. Macpherson Lees; "Recent Visit to the U.S.S.R.," by Mr. D. Dixon; "Tinted Frits for Sheet Iron, and (possibly) Cast Iron," by Mr. J. Semple; "Refractories," by Mr. D. Dixon; "Some New Thoughts on Old Enamelling Problems," by Dr. B. K. Niklewski; and a discourse on the work of the V.E.D.C., by council chairman Mr. S. W. Vickery, who was assisted by divisional chairmen Mr. C. S. Beers and Mr. N. F. Parker. An address was given by Mr. J. W. Gardom, I.V.E. past president and chairman of the technical committee.

NICKEL EXHIBITION AT CRANFIELD

THE properties and uses of nickel, nickel alloys and related materials is the theme of a four-day exhibition being held at the College of Aeronautics, Cranfield, from November 18-21. Organized by The Mond Nickel Co. Ltd., it is open to all industrial and commercial organisations in the area.

Coaches will be running a shuttle service between the college and the main line railway stations at Bedford and Luton. Arrangements have been made also for the college itself to be open each afternoon for visitors wishing to make a tour of inspection.

The exhibition includes numerous working demonstrations and displays, and is designed to inform engineers, designers, metallurgists and students of the latest developments in this field.

CENSOR AGENTS

Alfred Herbert Ltd. announce that they have been appointed sole distributors in the British Isles for measuring and inspection equipment made by Censor of Liechtenstein.

This equipment is made in two types: high-speed, high-precision ball, roller and needle sorting and grading machines for the bearing industry; and multi-dimensional inspection machines for very small parts.

This equipment is complementary to that made by the Sigma Instrument Co. Ltd., Letchworth, for which Alfred Herbert are the sole distributors.

Essays on Corrosion

S.C.I. Competition Again this Year

THE education panel of the Corrosion Group of the Society of Chemical Industry, established in 1955 a competition designed to encourage those who are still in the early stages of their career to take an interest in corrosion science and to express their ideas in writing. With the support of industrialists interested in the application of corrosion science in industry, a prize of the value of 25 gns. will again be awarded this year for an essay or paper on any aspect of corrosion of metals and its prevention.

Details are as follows :

Essays are invited from persons aged not more than 27 years on the closing date. A length of about 4,000 words is suggested, but reasonable latitude is allowable.

Judgments of the entries will be based on the candidate's critical faculty and originality of thought, and on technical and literary excellence generally. Results of original research may be incorporated, but this is not essential; entries may consist, for example, of surveys of knowledge in a particular field, discussion of practical problems, and suggestions for future developments in research, in application of knowledge, or in organisation of corrosion-preventive measures. A successful candidate may subsequently be invited to deliver his or her contribution as a lecture.

The closing date for receipt of entries is 31st March, 1959. Further information can be obtained from : Corrosion Group Essay Competition, c/o Society of Chemical Industry, 14, Belgrave Square, London, S.W.1.

AIRCRAFT STEPS HAVE ALUMINIUM CONSTRUCTION

THE telescopic aluminium stairway mounted on a tubular steel; chassis, seen in the picture below, provides a new type of aircraft passenger gangway. Easily transportable and readily adjustable in height to suit most aircraft it has been manufactured by Spurling Motor Bodies Ltd., and comprises two main stair assemblies. The height range is from 6 ft 3 in. when the upper assembly is retracted, to 10 ft. 7½ in. when it is fully extended; adjustment is by a direct action, manually-operated screw gear, preferred to a hydraulic system because of its lower maintenance costs. The choice of aluminium alloy sheet and sections for the construction of the two stair assemblies has kept weight to a minimum.

The panelling is of painted Noral 3S sheet on the outside, with unpainted patterned sheet of attractive appearance on interior faces. The steps have risers of the same patterned sheet and treads of Noral plain sheet. Plastic-filled wearing strips and edge nosing, and reinforcing sections, all of Noral alloys supplied by Northern Aluminium Co. Ltd., are fitted to each tread. Tubular handrails, fitted to both sides of the stairway, are of bright anodised Noral alloy.

FURNACE COS. MERGER

TWO of Britain's leading electric furnace manufacturers, Birlec Ltd. and Efco Ltd., have announced that negotiations between them for the formation of a new company to take over certain sections of their business have reached an advanced stage. It is intended that the new company shall be called Birlec-Efco (Melting) Ltd., and that its offices shall be near Birmingham, at Aldridge, Staffs.

The intended scope of the company is the design and supply of all types of electric melting furnaces for the ferrous and non-ferrous metals industries, together with smelting furnaces and induction heating equipment.

The personnel of the company will be drawn from the appropriate divisions of the two companies, thus combining in one organization the specialist techniques and extensive experience of both.

Birlec Ltd. and Efco Ltd. will continue independently to manufacture their respective heat treatment furnaces and other plant.

RECORD SHOW

A RECORD number of over 270 firms from 11 different countries have already applied for stand space in next year's International Plastics Exhibition to be held at Olympia, from June 17 - 27.

"SELECTIVE PLATING" TECHNIQUE

Fluxless Soldering for Instrument Components

A NEW production technique, developed by Dalic Meta-chemical Ltd., Toronto, Canada, allows aneroid elements of barometers, altimeters, depth gauges, and other pressure-sensitive devices to be soldered without flux, thus eliminating the chance of leaving corrosive material inside the diaphragm.

The Dalic "selective plating" techniques and solutions, can be used on diaphragms of silver, beryllium, copper, stainless steel, aluminium, and many other alloys, and avoid hand cleaning and possible mechanical damage.

Diaphragms are deoxidized electrolytically, rinsed, and the mating surfaces are then immediately plated with a flash of tin, or tin-lead alloy, to permit soldering without using flux. Halves should be joined within a few days, because the tin or tin alloy deposit will age, making it difficult for the solder to wet the surface.

When parts have to be stored for longer periods prior to soldering, a flash coat of gold is preferred to prevent oxidization.

A second method eliminates not only the flux, but manual soldering as well. After cleaning, 0.0005 in. of tin or tin/lead are deposited on each contact edge. Clamped diaphragms are then passed through a controlled-atmosphere oven at 500°F. to achieve a strong, leak-proof diffusion seal after 5 minutes exposure.

Dalic plating requires a modified

(*Continued in page* 447)

HOSPITAL EQUIPMENT EXHIBITION

THE second international hospital equipment and medical services exhibition will be held from May 25-30, 1959, again at Olympia but greatly enlarged, covering a total area of 75,000 sq. ft. over three floors.

Although the exhibition was originally planned as a biennial event, the one held this year was so successful it was decided that it should be held again in 1959. Sponsors are The Institute of Hospital Administrators and their official organ "The Hospital."

The Institute will again be holding their annual general meeting in conjunction with the regular three-day annual conference in the specially built conference hall. The Institution of Hospital Engineers are also holding their Annual General Meeting as an integral part of the exhibition.

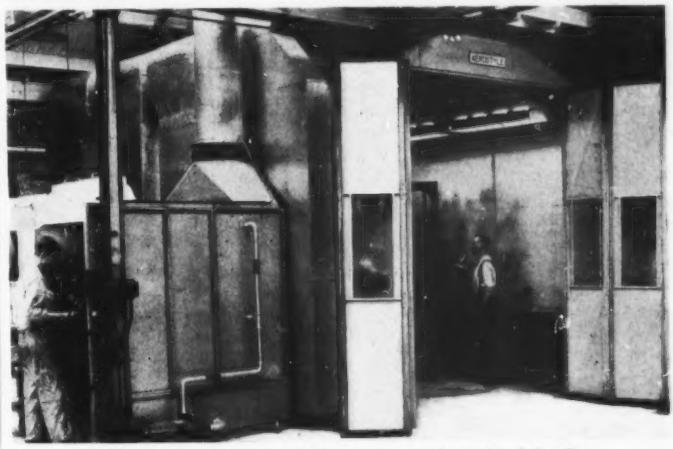
Details can be obtained from the organiser, at 40 Gerrard Street, London, W.1.

REHAB. COURSES

AT August 18, 1958, there were 1,372 persons undergoing courses at Industrial Rehabilitation Units run by the Ministry of Labour and National Service.

LEAD AWARDS

THE Lead Industries Association in the United States again presented Government savings bonds as awards to the three best lead workers in the international contest for plumbers' apprentices sponsored by the United Assen. of Journey-men.



Left, the open-fronted, and right, the totally enclosed, booths.

SPRAYING INSTALLATION AT ELECTROFLO

IN maintaining a high-quality paint finish of the various items of instruments, controls and instrument panels manufactured by Electroflo Meters Ltd., one of the greatest difficulties has been the problem of dust particles. A further difficulty is that components vary greatly in size so that unification of the finishing processes has not been easy.

When an extension to the Park Royal, London, factory became necessary Electroflo Meters approached their neighbour — Aerostyle Ltd. — with the problem.

A conventional open-front water-wash booth was not suitable for all purposes, so a totally enclosed made-to-order shop was constructed for spraying large instrument panels and cubicles. The booth, 22 ft. long x 11 ft. 9 in. high, was developed to filter incoming air and provide a safe, efficient exhaust system.

The prefabricated shop has been built of galvanized sheeting. Inducted air passes through metallic filters mounted above and on each side of the booth. Air outlets incorporate four dry exhaust filters. Four fans used in expelling exhaust air each have a separate push-button starter so that the volume can be easily controlled.

Rubber-sealed steel folding doors insulate the booth from the surrounding area and painted parts can be left for surface drying in a dust-free atmosphere.

For smaller workpieces, a 5 ft. open-fronted water-wash booth has been erected on one of the exterior sides of the spray paint shop. Its built-in exhaust is ducted through the main system.

PLATING SUPPLY HOUSE

Offices, laboratories and stores facilities

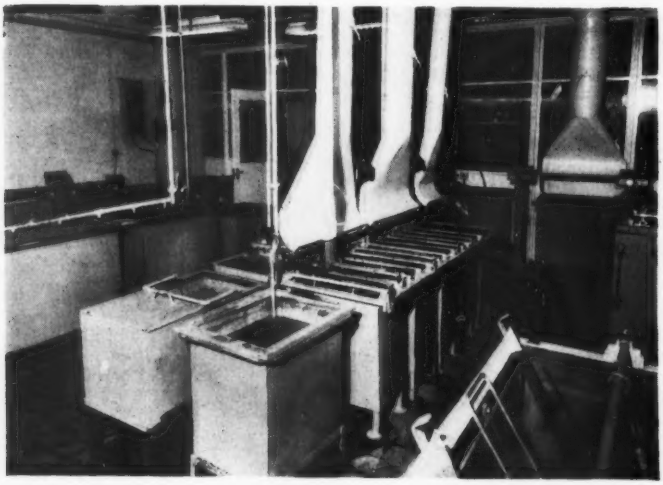
AN indication of the continued growth of M. L. Alkan Ltd., well-known as suppliers of processes and plant to the electroplating industry, has been their recent move to more commodious premises at South Ruislip, Middlesex. The new factory, which was occupied at the beginning of this year, has been designed to meet the specialized requirements of the company and offers considerably improved facilities compared with those that were previously available.

Fig. 1.—General view of the new Ruislip factory of M. L. Alkan Ltd.

The building, an external view of which is shown in Fig. 1 houses the offices, laboratories, the chemical preparation factory, and the main stores. The offices are situated in the front of the building and include a customers' reception room where problems and products can be discussed in comfort.

Immediately behind the offices at ground floor level, are the laboratories and pilot plant. This positioning enables effective and rapid liaison to be maintained between these two departments. The pilot plant, which is used for demonstration of processes, the processing of samples, and the investigation or evaluation of new products, is situated in a square room laid out with a tiled floor. Two views of the pilot plant are shown in Figs. 2 and 3. The plating solutions are contained in 50-gallon tanks arranged along the walls of the room with the services contained in a sealed channel beneath the tanks. Fumes from cleaning solutions and other solutions giving off noxious vapours e.g. hot cyanide solutions, are extracted by means of slotted hoods which make no demand on floor space. In order to facilitate the installation of the services, processes with similar requirements have been grouped together.

Fig. 2.—View of the pilot plating line showing cleaning tanks and experimental nickel and copper lines



Current supplies for the various processes are obtained from rectifiers housed in a separate room adjacent to the pilot plant, and a novel feature of the plant is that all the resistant boards for the various tanks are located in the rectifier room and operated by remote control at the side of the vat by means of a rotary selector switch. An ammeter and volt meter is mounted in an easy to view position alongside each switch.

Heating of the solutions is carried out in a variety of ways depending on the requirements of the various processes concerned. Both electricity and gas, direct and indirect are used.

The preparation and polishing of components for processing through the pilot plant is carried out in a specially equipped room adjacent.

Immediately adjoining the room housing the pilot plant is the electrochemical laboratory, where laboratory scale investigations are carried out into customers solutions and faults identified and corrected. In this laboratory also a certain amount of work is done on a small scale on the investigation and developments of new products and processes (Fig. 4).

NEW RUISLIP PREMISES

Improved services in expanding business

Two further laboratories complete the technical facilities, one of which is principally engaged in the analysis of customers solutions while the other is largely devoted to fundamental chemical development work. Situated behind the laboratory area are the departments engaged on mixing and manufacturing the various chemicals and solutions required for operating the processes supplied by the company. This work is carried out in a series of bays under carefully controlled conditions with particular attention being paid to the provision of adequate ventilation.

The company's own experience in the works of their customers has made them very conscious of the problems involved in the disposal of liquid effluent, and the outflow from the different sections of the factory is separately treated before being mixed and passed to a settling tank.

The activities of the company are mainly concerned with supplying and servicing the very wide range of products and processes of American origin for which they are the sole British agents. In most cases the selling and manufacturing rights are not confined to Britain but extend to a number of European and overseas countries.

The view is taken by the company that while processes developed in the U.S.A. figure largely in the proprietary solutions in current use in the U.K., it does not necessarily follow that all these processes are always suitable in their existing form for the British market. It is for this reason that the company represents such a large number of principals and the search for and investigation of new processes is constantly being maintained.

Inevitably in the course of its activities the company has developed a range of its own products and one of the best known of these is the barrel plating unit. Further more, appreciating the current growing trend towards mechanization in the electroplating industry, steps are being taken to set up a separate organization to manufacture conveyorized plant. Also in train is the establishment of a research section to investigate certain aspects of the pretreatment and finishing of metals, which it is hoped will make some worthwhile contribution to the work on this subject already being carried out in this country.

The orientation of the company's sales policy is derived largely from a proper appreciation of the fact that although modern proprietary processes offer considerable economic advantages over those previously available, it is necessary that these shall be operated at maximum efficiency to derive full benefit from them, and in order to ensure this a proper and efficient technical maintenance and after-sales service is vital.

The company led and inspired by the enthusiasm of its founder, is confident of the future of the industry, and although the factory is not yet one year old, already plans are being made for modifications and extensions to accommodate new products which will be introduced to the British market in 1959.

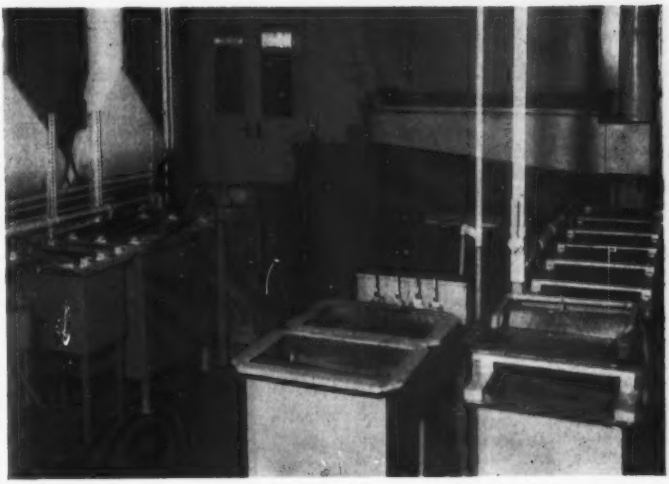


Fig. 3.—Another view of the pilot plant showing the chromium plating tank and metal stripping line.

Fig. 4.—Part of the electrochemical laboratory devoted to investigational and development work.

PURE WATER

A short while ago one of the largest manufacturers of transistors in the country became alarmed at the percentage of rejects despite every effort to improve the production methods. The cause, unsuspected in the early stages of the failures, was ultimately located in the water used for the washing and rinsing of germanium components.

Plant was already installed for the production of deionised water but, on its way through stainless steel ducting, the water acquired sufficient ions to raise its electrical resistance, and contamination of the parts resulted. The remedy was the installation at each point of application of a small mixed-bed deioniser ; since almost pure water was being fed into it, each unit gave some thousands of gallons of completely pure water.

The deionisers in this case were Griffin-Raleighs, an inexpensive tool with low regeneration costs, manufactured by Griffin and George Ltd., Ealing Road, Alperton.

ADHESIVE JOINTS

THE American Welding Society is including material on adhesive bonding and the welding of plastics in Section III of its "Welding Handbook," to be published in the autumn of next year. The A.W.S. thinks that this is probably the first time an engineering society in the U.S. has given official recognition to modern adhesives as structural joining materials.

The welding handbook follows the Society's recommended practices. The inclusion of material on adhesives and plastics is a departure from previous policies, and provides information on the use of metal-joining methods, and the best available method irrespective of whether the material used is organic or inorganic, metallic or non-metallic.

The decision to include authoritative information on adhesives and plastics will be welcomed by engineers who will now be able to look to an old established engineering society for technical information.

TECHNICAL *and* INDUSTRIAL APPOINTMENTS

Mr. R. F. Webb, B.Sc., Ph.D., formerly a lecturer in natural sciences at Cambridge University and a fellow of Trinity Hall, Cambridge, has joined the staff of **CIBA (A.R.L.) Ltd.,** Duxford, Cambs., where he will direct the activities of a number of specialist groups engaged in long-term research in new plastics materials.

* * *

The appointments of Mr. Albert P. Gagnebin as a vice-president and Mr. Joseph M. Weldon as an assistant vice-president of **The International Nickel Company Inc.,** were announced recently.

Mr. Gagnebin became manager of the nickel sales department in April, 1956. His association with International Nickel dates from 1930. After graduate studies in metallurgy, he joined Inco's research laboratory at Bayonne, New Jersey, in 1932 and carried out research on ferrous metals. He was in charge of the ductile iron section of Inco's development and research division during the industrial development of this material, of which he is a co-inventor. In May, 1952, Mr. Gagnebin was a co-recipient of The Peter L. Simpson gold medal award of the American Foundrymen's Society, and is the author of many technical papers and the book, "The Fundamentals of Iron and Steel Castings."

Mr. Weldon has been assistant to the vice-president of International Nickel since December, 1953. He first became associated with the company in 1927 and has held various positions in the sales, executive and other departments.

* * *

British Titan Products Co. Ltd., 10, Stratton Street, London, W.1, have announced the appointments of Mr. N. D. Harris, Dr. P. A. Lintern and Mr. S. G. Tinsley as directors of the company.

Dr. Lintern and Mr. Tinsley have been with the company for many years. Mr. Harris was formerly chairman of I.C.I. (India) Ltd.

Mr. C. N. Taylor has been appointed home sales manager of the company and will work from the London office.

* * *

Mr. F. J. Havenith has been appointed local resident director on the board of George Kent Ltd.'s Belgian subsidiary company, **Kent-Continental S.A.**

Mr. Havenith has been the manager, first of Kent's Brussels office and subsequently of the Belgian company, since its formation. In addition to his work in the Belgian market, he has direct supervision of Kent offices and activities in Germany and Holland.

Mr. R. F. Webb

* * *

Mr. Richard Turner has been appointed a managing director of **Johnson, Matthey and Co. Ltd.,** as from the 1st October, 1958.

He relinquishes his position of managing director of Mallory Metallurgical Products Ltd., a subsidiary company, but remains a director.

* * *

George Kent Ltd., Luton, Beds., have announced the appointment of a new director, Mr. T. P. W. Norris, lately chief personnel officer of the Vickers Group, previously labour manager of I.C.I. Billingham Division, and a former president of the Institute of Personnel Management. Mr. Norris has been appointed as deputy chairman.

Mr. R. E. Handford, B.Sc., deputy managing director, after 45 years in the company's service and 25 as a director, relinquishes his executive functions and retains his seat on the board. Mr. W. A. Hartop, who joined the company in 1927, and was appointed to the board in 1943, has been appointed managing director. Commander P. W. Kent, formerly chairman and managing director remains as chairman.

Two directors of the company have retired: Mr. W. Guy Ardley and Mr. Leslie H. Kent.

* * *

Mr. E. A. Langham, **The British Aluminium Co. Ltd.'s** resident representative in Australia, will be returning to the U.K. early in 1959 ; he will be succeeded by Mr. G. A. Daniels.

BATTERSEA CORROSION EXHIBITION

S.C.I. Group Meeting to be held in January

THE *conversazione* of the Society of Chemical Industry corrosion group will again be held at the Battersea College of Technology. Exhibits illustrating corrosion work carried out in the laboratory or in service will be displayed and offers to provide these are invited. The event will be held on January 22, next.

This year, apparatus and techniques are to be specially featured, but any exhibit illustrating recent or current corrosion work will be welcome.

Early notice is helpful although it will be possible to include exhibits offered up to January 8.

Further details can be obtained from Dr. L. L. Shreir, The Battersea College of Technology, Battersea Park Road, London, S.W.11.

OBITUARY

Mason: The sudden death of Mr. Cecil C. Mason at the age of 77, was reported recently. He was a member of the board of the Cambridge Instrument Co. Ltd.

Mr. Mason joined the Cambridge Instrument Co. in 1910. He was a joint managing director from that year until his retirement from executive work in 1941, and he remained on the board until his death. Awarded the O.B.E. for his work on shell fuses in the first world war, Mr. Mason was not only responsible for many other technical advances in the instrument field, but also made major contributions to the company's growth through his wise administration and financial acumen.

Pickering: Mr. E. G. Pickering, a joint managing director of Johnson, Matthey and Co. Ltd., has died after a prolonged illness.

Spence-Brown: The death was announced recently of Mr. F. A. Spence-Brown, who was also a joint managing director of Johnson, Matthey and Co. Ltd.

Zick : The death of Mr. Bob Zick on October 23, as a result of a motoring accident robs the vitreous enamelling industry of a well-known personality. Mr. Zick, who was technical representative with Ferro Enamels Ltd., Wombourn, Wolverhampton, was a frequent contributor to the literature on enamelling subjects, and sorrow at his untimely death will be widely felt.

BUILDING EXHIBITION

NEXT year's Building Exhibition will be held from November 18-December 2 at Olympia.

An innovation will be a section exclusively reserved for material and equipment used in the painting and decorating industry, organised in collaboration with the National Federation of Master Painters and Decorators of England and Wales. The Federation will have its own stand and a visitors' lounge. Cinema facilities will also be available so that an exhibitor can show his own films.

CHANGE OF NAME

THE name of The Aerograph Co. Ltd. has now been changed to The Aerograph-DeVilbiss Co. Ltd. to link more closely with the symbol "Aerograph-DeVilbiss," the well-known spray painting equipment. The company's registered trade mark remains the same.

"Selective Plating"

(*Continued from page* 443)

rectifier having its cathode lead clamped to the diaphragm itself, and the positive lead connected to a graphite anode in a stylus. After wrapping the graphite with long-fibre cotton, and saturating it with the proper electrolyte, the wet stylus is passed over the exact area to be plated. Thus, finely controlled and sharply defined deposits are possible without extensive masking. With a change of anode and solution, almost any metal can be deposited on any other, without large, costly tanks or a heavy investment in electrolytes, says the company.

Claims made for the process are that it can provide corrosion protective finishes for complete instrument assemblies and housings; simplify soldering of aluminium and its alloys; build up overmachined parts to correct dimensions; ensure precision fits between bearings and housings; protect local areas during carburizing or hardening; produce electroforms ; improve wear resistance; reduce arcing; and perform many similar production and maintenance operations.

Additional information on the process can be obtained from the company's U.K. associates, Metachemical Processes Ltd., Crawley, Sussex.

NEW COMPANIES

" Ltd " is understood, also " Private Co." Figures = Capital, Names = Directors, all unless otherwise indicated.

Timberlast, 12, Colston Street, Bristol, 1. September 10. £1,000. To carry on bus. of manufacturers of and dealers in paints, etc. Leonard J. Andrew, Keith B. Beetlestone, Mrs. Margaret Andrew and Hazel C. Beetlestone.

Willowchrome, 3/7 Cross Lane, Earlestown, Newton - le - Willows, Lancs. September 18. £1,000. To carry on bus. of electro-platers, etc. Thomas H. Daniels and Mrs. Joan Daniels, Percival G. Preston.

G.B. (Enamelling), 1, Dunraven Street, W.1. September 18. £100. To carry on bus. of enamellers, metal sprayers, etc. Gyula Balogh, Alfred V. Freeman.

Precise Electro-Plating Works, Dyer Road, Southampton. September 22. £1,000. Leonard J. Samways, Harry R. V. Wilson.

Press-Chem, 45/7, Park Road East, Acton, W.3. September 22. £1,000. To carry on bus. of manufacturers of instruments for use of chemicals; to carry out operations in connection with chemical processing; to carry on bus. of chemical manufacturers, etc. Maurice N. Mitchell, John B. Jeyes.

Broma Art Enamellers, 10, Avenue Industrial Estate, Southend Arterial Road, Romford. September 29. £1,000. To carry on bus. of cellulosers, paint sprayers, etc. Fredk. H. Brown, Donald J. Major.

Ultrasonic Applications, 32, Finsbury Square, E.C.2. October 2. £1,000. To carry on bus. of manufacturers of and dealers in apparatus for the production of ultrasonic, sonic, infrasonic and elastic waves and electro-magnetic radiation for use in industry, medicine and science, etc. Jean-Jacques Renaut, Paul E. Renaut, John F. Miller.

Permacel Tapes, 260/262, Bath Road, Slough, Bucks. October 8. £10,000. To carry on bus. of manufacturers of and dealers in tapes, including pressure-sensitive and other kinds of adhesive and non-adhesive tapes, etc. John F. Brooke, Harry F. T. Wren, William L. Thomson.

From the Register compiled by Jordan & Sons Ltd, 16, Chancery Lane, London, W.C.2

Anglo-Dutch Trade Council

F.B.I. and Chambers of Commerce Move

THE formation of an Anglo-Dutch Trade Council was announced recently by the Federation of British Industries. The F.B.I., which with the Association of British Chambers of Commerce was one of the bodies that initiated the formation of the Council, regards this as a most important step towards the promotion of British trade with Holland.

The address of the Council is 99, Jan Van Nassaustraat, The Hague, Holland, and the name of the Secretary is Mr. H. N. Schepp.

Holland is Britain's sixth largest export market, coming after only four Commonwealth countries and the U.S.A. She is by a considerable margin our biggest customer in Europe: in 1957, Holland bought about £120,000,000 worth of British goods, although this in itself represents only about 8 per cent of her total imports, and imports from Germany were well over double the U.K. figure.

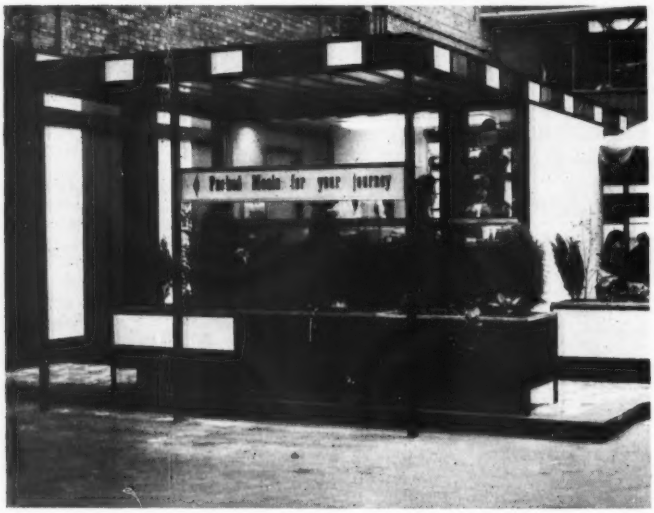
There has been a Dutch Chamber of Commerce in London since 1890, but until now there has been no similar British organization in Holland.

Importance in Common Market Trade

Apart from its importance as a market for British goods, Holland is bound to play an increasingly important role in British trade with the advent of the common market and ultimately of a free trade area. The Council is expected to play a prominent part in these developments.

The chairmen are Mr. Duncan Oppenheim (chairman of the British-American Tobacco Co.) and Dr. Paul Rykens (lately chairman of Unilever N.V. of Holland). Twenty leading British and Dutch businessmen have been appointed to the general council.

Coated Sheet for B.R.



REFRESHMENT TERRACE AT EUSTON

A gay and colourful continental-style refreshment terrace has recently been opened at Euston railway station. It has been constructed mainly in "Stelvetite," the plastic-coated steel sheet made by John Summers and Sons Ltd., Shotton.

It is the only one of its kind in Britain, and is open day and night. There is a special kiosk for serving packed meals for passengers in a hurry ; the terrace with tables and multi-coloured umbrellas is for passengers with time to spare. Flowers and shrubs surround the floodlit enclosure, and air conditioning and central heating maintain a pleasant temperature.

Sheets of red, black and white Stelvetite have been used as a "backcloth" for the terrace, and these have been secured with adhesive to a wooden framework attached to the brickwork.

The three colours of Stelvetite are used in other parts of the terrace for the shrub and flower boxes, and for various panelling. The flooring is in random marble.

MORE EMPHASIS ON FINISHING

PRODUCT finishing in industry will be an important aspect of next year's Factory Equipment Exhibition to be held at Earls Court, London from April 7 - 17, 1959.

Mr. J. E. Holdsworth, the exhibition organiser, said recently that in line with the aim to present, at each succeeding exhibition, a display of equipment and methods designed to meet every industrial need, greater stress would be laid on product finishing at the next exhibition.

He said the range would include materials and equipment used in cleaning and preparation ; filters, humidity, extraction and drying plant; protective tapes, masks and clothing; enamels, paints and lacquers; the various spraying and other finishing methods; and many other items.

AGENCY FOR U.S. OIL BURNERS

THE Hauck designed fully proportioning oil burner, together with ancillary equipment, developed by the Hauck Organisation of America can now be supplied in the U.K. by Stordy Engineering Ltd., Cumbria House, Goldthorn Hill, Wolverhampton, Staffs.

The range includes a micro-cam oil valve ; a self-clean metering oil valve ; a proportioning oil burner ; a combination proportioning oil and gas burners ; and radiant tube burners (for either oil or gas).

COLOUR PANELS IN BUILDING

A.D.A. Sponsor Exhibition in London

RECENTLY in conjunction with the Building Centre, London, the Aluminium Development Association staged an 11-day exhibition to demonstrate the effects now available with colour anodized aluminium for building exteriors and other outside decoration.

The exhibition was opened by a discussion amongst invited representatives of architectural organisations, fabricators and anodizers, presided over by Mr. J. H. Mayes, chairman of the building and structural engineering committee of the A.D.A. Mr. Mayes emphasised that the availability of larger sheet, plate, sections and castings, and the perfection of anodizing and colouring techniques now consituted an assured technical achievement backed by tests and full scale usage.

Facilities Available

Three members of the Association's technical staff outlined the extended production and anodizing facilities now available, and the properties of the anodic finishes, with colour slides of typical applications.

These were: "Fabrication and anodizing facilities, including colour range" (Mr. J. C. Bailey); "Characteristics of the finish acceptance specification, durability, erection and maintenance" (Mr. F. C. Porter); and "Suitable types of application with description of existing installations illustrated with projected colour transparencies" (Mr. H. W. Johnson).

The exhibition opened to the public comprised examples of colour anodized aluminium made up into curtain wall panels together with cut away mock-ups showing different combinations and including cladding systems, spandrels and windows.

Other panels showed the full range of available colours both on plain aluminium and aluminium-silicon alloy coated sheet. In this connection a colour chart had been prepared to indicate the colour range at present available, and the chart is available on application. Other publications on the subject are also available from the Association at 33, Grosvenor Street, W.1.

CHANGE OF ADDRESS

HAVING moved recently from Britannia Street, London, W.C.2 Translation and Technical Information Services are now at 32 Manaton Road, London, S.E.15. The firm provides specialised information services for the paint and plastics industries throughout the world, and issues a monthly technical bulletin.

MEETINGS OF THE MONTH

November 17

Institute of Vitreous Enamellers (Midland Section). "Acid Pickling," by G. F. Whitmore, at the Birmingham Exchange and Engineering Centre, Stephenson Place, Birmingham. 7.30 p.m.

November 19

Institute of Vitreous Enamellers (Southern Section). "Service Man's Aspect of Vitreous Enamelling," by D. L. Mill (Escol Products Ltd.), at the Howard Hotel, Norfolk Street, London, W.C.2. 7.15 p.m.

November 20

Institute of Metals (Sheffield Section). "Chromium and its Alloys," by E. A. Brandes, in the engineering lecture theatre, The University, St. George's Square, Sheffield. 7.30 p.m.

November 25

Institution of Chemical Engineers. "An extended equation for the Performance of Machines Mixing two Powders," by H. E. Rose, at the Geological Society, Burlington House, London, W.1. 5.30 p.m.

Institution of Chemical Engineers (North Western Branch). "Pollution Law and the Chemical Engineer," by R. R. Ferner, at the Birkenhead Technical College, Birkenhead. 7 p.m.

November 27

Institution of Electrical Engineers (Utilization Section). Symposium of papers on "The Provision of Adequate Electrical Installations in Buildings," at Savoy Place, London, W.C.2. 2.30 p.m.

Institute of Metals (Birmingham Section). "Corrosion and the Microstructure," by C. Edeleanu, at the Birmingham Exchange and Engineering Centre, Stephenson Place Birmingham. 6.30 p.m.

November 28

Junior Institution of Engineers. Annual General Meeting, at Pepys House, 14, Rochester Row, London, S.W.1. 7 p.m.

December 4

Society of Chemical Industry (Chemical Engineering Group). "Titanium and its Alloys as Materials of Construction for Chemical Plant," by Dr. K. W. J. Bowen, at the Chemical Dept., University of Bristol, Woodland Road, Bristol. 6 p.m.

Birmingham Paint, Varnish and Lacquer Club. "Pretreatment and Finishing of Zinc Coatings," by P. Costello, at Imperial House, Temple Street, 7.50 p.m.

December 8

Oil and Colour Chemists' Association (Midlands Section). Informal Dinner. 7.50 p.m.

December 10

North Wales Metallurgical Society. "Metallurgy, Commerce and Zinc Surfaces," by W. H. F. Tickle (John Summers and Sons Ltd.), at the lecture theatre, Flintshire Technical College, Connah's Quay. 7 p.m.

December 11

Institute of Physics (Midland Branch). Works visit to I.C.I. Metals Divn., Witton. New Metals, by Dr. T. W. Farthing. 2.30 p.m.

December 12

Society of Instrument Technology (Midland Section). "pH Measurement and Control," by J. W. Broadhurst, at Regent House, St. Phillips Place, Colmore Row, Birmingham 3. 7 p.m.

December 17

Incorporated Plant Engineers (North East Branch). "Treatment of Trade Effluents and Methods of Purification," by T. Waldmeyer (Reed Paper Group), at the Kings Head Hotel, High Street, Rochester. 7 p.m.

December 19

Society of Chemical Industry. "Modern Views of Electrochemical Processes" (1) "Cathodic Processes," by E. C. Potter; (2) "Anodic Processes," by T. P. Hoar, at 14 Belgrave Square, S.W.1. 2.30 p.m. and 5.30 p.m.

TRADE and TECHNICAL PUBLICATIONS

Leaflet No. M21a, entitled "Bench Type Muffle Furnaces," has been issued by Metalectric Furnaces Ltd., Resistance Furnace Division, Cornwall Road, Smethwick, 40, Staffs. Metalectric bench type muffles are designed for toolroom and laboratory purposes up to 1,000°C. A manually operated energy regulator is used to control the temperature. The furnaces have been designed to give long trouble-free service without attention, and are simple to operate.

* * *

Three brochures describing American "Hauck" items of oil burner equipment have been issued recently by Stordy Engineering Ltd., Cumbria House, Goldthorn Hill, Wolverhampton, who are making these under licence in this country.

Numbered 90, 100 and 110, they comprise a proportioning oil-burner, a self-clean metering oil-valve, and a micro-cam oil valve, respectively. All three are instruments of precision to provide better combustion and accurate control of furnace temperature and atmosphere. The brochures are well illustrated with sectioned drawings of the equipment and tables listing the capacity of the items. Available free on request.

* * *

The October issue of I.C.I's "Pretreatment News" carries a topical feature — metal pre-treatment of the new 3-litre Rover, using 'Granodine' 30. Another feature describes the pre-treatment of car heaters at the Motor Accessory Division of S. Smith and Sons (England) Ltd. at Witny, Oxon. 'Granodine' 400 and 'Alocrom' processes to clean and degrease the metal and simultaneously deposit a phosphate coating are used. Sprayed onto the surface, the smooth grey coating that 'Granodine' imparts has been found to be ideal for the subsequent one-coat dipping finish. Circulation list.

* * *

A 16-page illustrated brochure (Bulletin 5412) describing the new "American Blower" line of special purpose air moving units for special equipment manufacturers is now available from American-Standard, American Blower Division, Detroit 32, Michigan.

More than 50 designs are illustrated and described in the bulletin. Products covered include centrifugal blowers, vane-axial fans, tube-axial fans, propeller fans, pressure blowers and fluid coolers.

Size of the units ranges from a fan with a wheel dia. less than 4-in. to a large volume centrifugal design having a wheel dia. of more than 16-in. Free on application.

* * *

A recently issued booklet "The proceedings of the first advanced purchasing course held at Christ Church, Oxford, April, 1958" reproduces the full text of the lectures given by Professor Howard T. Lewis of the Graduate School of Business Administration, Harvard University, at the advanced purchasing course conducted by The Purchasing Officers Association.

In his lectures Professor Lewis deals with the increasing importance of purchasing as a management function in an age of automation, computors, and operations research, and with the latest American techniques applied to forward buying, value analysis, vendor relations, and purchasing performance evaluation.

Short papers on each of these subjects by British authorities are also included, together with individual comments on the lecturer's points and his replies.

Three very detailed case-problems are presented, followed by Professor Lewis's analysis of their solution, and the booklet crystallises the very latest thinking of the most up to date practical procedure in some of the most important industrial purchasing problems. Price 10s. 6d. from the Purchasing Officers Association, Wardrobe Court, 146a Queen Victoria Street, London, E.C.4.

* * *

Wallace and Tiernan Ltd., Power Road, London, W.4., have now published a number of technical publications, translated into French and German, describing their equipment.

Publications in French describe the new V-notch chlorinator type A-711B, chlorinator type A-678B and chlorinator type A-419B. In addition, publications in French are available describing the new dissolved oxygen recorder, E.C.D. pumps and E.C.D. ozone equipment. A booklet on the "Chlorination of condenser cooling water" is also available in French.

Publications in German describing the equipment are also available from the London office, or from their factory in Germany. Free on application.

* * *

The publication was announced recently of an entirely new and up-to-date version of a booklet on "Cerrux" stoving and air drying finishes.

There is a centre schedule which contains a comprehensive list of products for metal finishing, together with particulars of stoving times and temperatures, drying characteristics, viscosity, thinner reference, etc. Available free from Cellon Ltd., Kingston-on-Thames.

* * *

Temporary List 144/B/1 Cambridge Gas Analysers, primary measuring group, describes the equipment made by the Cambridge Instrument Co. Ltd., 13 Grosvenor Place, London, S.W.1.

All gases, whether elements or compounds, possess the property of thermal conductivity, and the Cambridge analysers use a method based upon this.

Nearly all the advantages claimed for the method are due to the unique properties of a precision-built katharometer (analysing element) which gives a highly flexible output in the form of an electrical signal. It has no moving parts, and is compact, light, very strongly made, and can be supplied from any reasonably stable DC source.

A complete anlyser outfit consists basically of two main groups ; the primary measuring group, comprising the katharometer and accessory equipment such as absorption chambers, aspirators, flow gauges, regulating valves, etc., and the final measuring and control group, comprising indicators, recorders, controllers, and their associated equipment. The former is usually mounted on a panel or frame ; the latter can be installed considerable distances away from the analyser panel, although it is sometimes convenient to mount both groups on the one panel.

Since the sample gas may contain dust particles, various types of condensation products, and other interfering substances — some of them corrosive — accessory equipment is often required in addition to the basic analyser components. Excessive variations of temperature, pressure, and flow adversely affect the performance, and further equipment to compensate for, or control, these variables is sometimes essential. The list is available free on request.

Latest Developments in PLANT, PROCESSES AND EQUIPMENT

Resin Dispenser

A POSITIVE displacement, resin dispenser for use with liquid resin and hardener systems was announced recently by the Delsen Corpn., 719 West Broadway, Glendale 4, Ca., U.S.A. Accurately calibrated to meter both liquid hardeners and resin in exact proportions, they say it has been serving a useful purpose in plastic fabricating plants, eliminating the necessity for time-consuming weighing operations (Fig. 1).

The resin material is accurately metered through drip-proof valves, and both hand-driven and motor-driven models are available. Motor-driven units are available either with or without explosion-proof housings of the motor and switch. The Delsen dispenser unit is now in use by companies employing liquid resins in aircraft, marine, automotive and missile equipment. It will function satisfactorily for most two-component adhesive and coating systems.

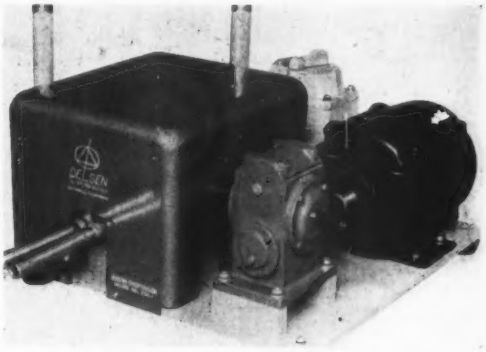


Fig 1.—A dispenser to meter hardeners and resins in correct proportion for use in 2-component systems.

Water Deioniser

THE use of mixed resin ion exchange techniques make it at once possible to obtain, straight from the tap and at a fraction of the cost of commercially distilled water, effluent having a quality equivalent to that formerly realised only by triple vacuum distillation in quartz.

Griffin and George Ltd., Ealing Road, Alperton, Middlesex, say that the Griffin-Raleigh water deioniser has been developed as a result of an invention in ion exchange technique employing three resins instead of two, by which it has become possible to regenerate small columns *in situ* and to produce extremely pure water at a cost of approximately 3*d* per 20 gal. when using London mains water as the raw influent. In areas such as Belfast or Plymouth, where the raw water contains a very small proportion of dissolved electrolytes, deionised water can be obtained for as little as 3*d* per 200 gal.

Water having a specific resistance within the range 3-15 x 10^6 ohms is finding an increasing application not only in the laboratory but also in industry, where it is used in the preparation of pure chemicals and in the washing of components subsequent to treatment with acids and other electrolytes.

Water produced by simple distillation almost invariably contains significant traces of metal ions, dissolved carbon dioxide and silica and has a pH value which is always less than 7 and often as low as 5.9.

The removal of ionic impurities by adsorption on mixed cation and anion exchange resins provides a solution to this important problem, and this method is widely used in large scale processes. Mixed bed laboratory deionisers have been based in the past upon exchangeable cartridges which could be replaced on exhaustion, and while this method gives satisfactory results it is one which is inevitably expensive.

The Griffin-Raleigh deioniser makes use of a new process enabling mixing and reclassification of the resins to be carried out in columns down to 3 in. diameter, thus making it a simple matter to regenerate the resins in situ. A built-in amplifier and a bridge circuit incorporating a conductivity cell enables effluent quality to be monitored, and the circuit is independent of mains voltage and temperature fluctuations.

The deioniser is supplied ready for use in two sizes giving 16 and 64 gal. of pure water per regeneration respectively, and the price of these units compares favourably with that of the older replaceable cartridge types, say the makers. Using mains water, flow rates of 5 and 20 gallons per hour may be employed with an effluent conductivity of 0.2 micromho. Using as influent either single distilled or two-bed deionised water the effluent conductivity may approach 0.05 micromho and an inter-regeneration capacity of several thousand gallons is realised.

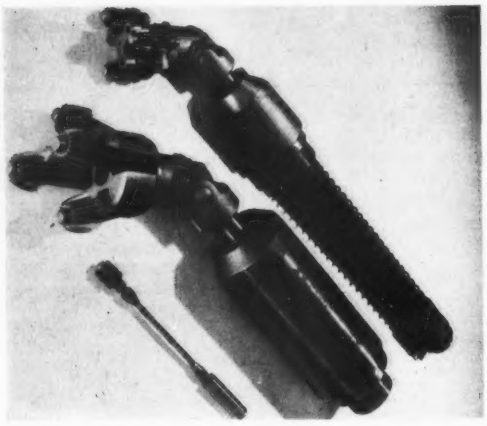


Fig 2.—Pneumatic equipment suitable for cleaning tubes from ½ in. to 6 in. or more in diameter.

Tube Cleaning Equipment

DETAILS of the range of Lagonda tube cleaning equipment which Consolidated Pneumatic are now producing at their Aberdeen Works were released recently.

The range includes three sizes of vane-type motors available to operate a variety of cutting heads for dealing with straight or curved tubes from ½ in. to 6 in. or more internal dia. (Fig. 2).

The smallest motors are those of the 600 series, designed specifically for use on small straight to tubes having internal dia. from 0.495 to 1.820 in. I.D. and curved tubes with dia. of from 0.791 to 2.080 in. I.D. having a minimum radius of 6 in. The 600 series, comprising some 8 models of motors includes short and long bodied units which house miniature vane-type air motors, the short motors being used for curved tubes and the long motors for straight tubes, both the motors and the cutters with which they are used being designed to ensure optimum use of maximum power.

The 1300 series motor has been produced for cleaning in the tube range of $1\frac{3}{4}$ to $3\frac{5}{8}$ in. I.D. for both straight and curved tubes. For larger tubes of over $4\frac{1}{4}$ in. I.D., sleeves are fitted over the motors. A force feed oil lubrication system delivering oil under pressure to the bearings is a particular feature which, together with a simple construction of the vane motor, keeps maintenance to a minimum. This series has a very wide application apart from boiler plant maintenance.

The 1100 series constitutes a range of heavy duty motors for dealing with straight tubes only in the size range of $2\frac{1}{4}$ to 6 in. I.D. In this motor, developed originally for refinery service, ball thrust bearings at both ends accommodate rotor drag due to operator thrust when working a heavy deposit, and prevent friction due to pulling of the self feeding cutter heads, the bearings being lubricated by forced feed.

A very wide selection of cutter heads and brushes is available. All cutter heads are, however, variations of straight and trackless cone cutters in which the spacing of the cutter teeth or blades is so arranged that any one tooth does not return to the same point in a tube in successive revolutions of the head. This prevents the formation of a tooth design in the tube and ensures an even finish. To withstand severe service, cutters and other head parts are heat treated. For straight tubes, the cutter heads are directly coupled to the shaft of the motor used, whilst to obtain flexibility in curved tubes, a universal joint is always used between the cleaner motor and the cutter.

Apart from much straightforward general service, there is a great number of specialised applications for this equipment. An instance is the removing of spent catalyst material from reactors and convertors of the tubular type using exhaust air to carry the recovered material up the tube and away past a deflector and dust seal to a container. Other specific uses include the cleaning of air preheaters which have become completely plugged with fly ash.

High-Temperature Kiln

A NEW high-temperature kiln has been recently introduced by the allied engineering division of Ferro Enamels Ltd., Wombourn, Woverhampton, for applications demanding wide firing curve flexibility. The kiln is claimed to be eminently suitable for refractories production development, filling the gap between the laboratory test kiln and production furnace kiln. It is also said to be suitable for production of high-temperature ceramics.

The equipment incorporates a catenary arch forming the roof and side walls of the firing chamber, an advantage when it is subjected to fast heating and cooling cycles over the more commonly used arch of constant radius which relies on the support of external steel members, say the makers.

The method of firing is down draught through a low wide setting. A simple burner fires over the charge, flame propogation developing in the apex of the catenary. In this way any flame impingement is confined to the wicket rather than the charge. The catenary facilitates ideal distribution of the products of combustion through the charge to the floor of the kiln where they are exhausted through a series of adjustable slots, to provide close temperature uniformity with varying charges. The spent products of combustion pass to a suitably dampered stack through a 3-pass silicon carbide recuperator supplied with the kiln ; this provides hot combustion air to the Allied medium-pressure water-cooled burner.